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ASTRONOMICAL CONTENT OF NORTH AMERICAN PLAINS INDIAN CALENDARS

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INTRODUCTION

It is very rare to find history of our North American Indians kept by the Indians themselves. Until recently, they wrote no books. We do find marks and pictures on rock, animal hides, sticks and other materials some of which represented events in their lives, but no one can now interpret most of these with certainty. Mostly, they handed down their histories from generation to generation orally. History was kept locked up in the memories of their shamans, priests, chiefs, tribal historians and common people, then selectively passed on, but mostly forgotten. Yet it is clear that these people were concerned about their histories being remembered. A Teton Sioux proverb, for example, is interpreted, "A people without history is like wind on the buffalo grass" (Blish 1967: xix; Turner 1973: 135). It is known that oral traditions were of great importance to most Native Americans and some of them developed ways of trying to keep their past alive by more than mere memories. Thus we find special kinds of Indian arts which indicate something about the thinking of the Indians and depict events in the lives of individuals and groups.

Any type of chronological record kept by early Indians is very rare and should be valuable to all of us. One type of calendric record which has survived was kept by Indians of the American Plains: notably the Sioux; also by some Kiowa, Mandan, Hidatsa, Ponca, Blackfoot and perhaps others. It is usually referred to as a "winter count".

Among the Sioux, years were referred to by the same name as were winters. The year started with the first snowfall and continued through the cold months, the spring awakening, the hot summer and the fruitful autumn until the next snow, which was considered to usher in a new year.

For at least 200 years some of the Sioux people kept chronological records—counts of their years or winters. The seven bands of the Teton division of the Sioux and the Yanktonai band of Middle Sioux kept such counts, as did some other plains groups. A tribal historian, keeper of the count, in council with other important tribesmen, selected one event at the end of each year to remember that year by. The keeper then derived a pictograph to represent the event and year, and a phrase or name for the year. He also memorized other important information to recall in association with the name and picture.

The winter count chronological system is fundamental. It is a formalized method of societal memory in common informal use by people throughout history everywhere. How often do we hear or say, "That was the year when . . . "? The winter count record was a picture memory-book and the tribal historian was editor and curator of the volume.

Thus the historian's job was to remember the years and what transpired during them. To do this, he kept a painting with all the annual symbols in sequence. Originally the pictographic counts were on tanned animal hides. These were useful as a tribal record, and for individuals within the tribe as well,

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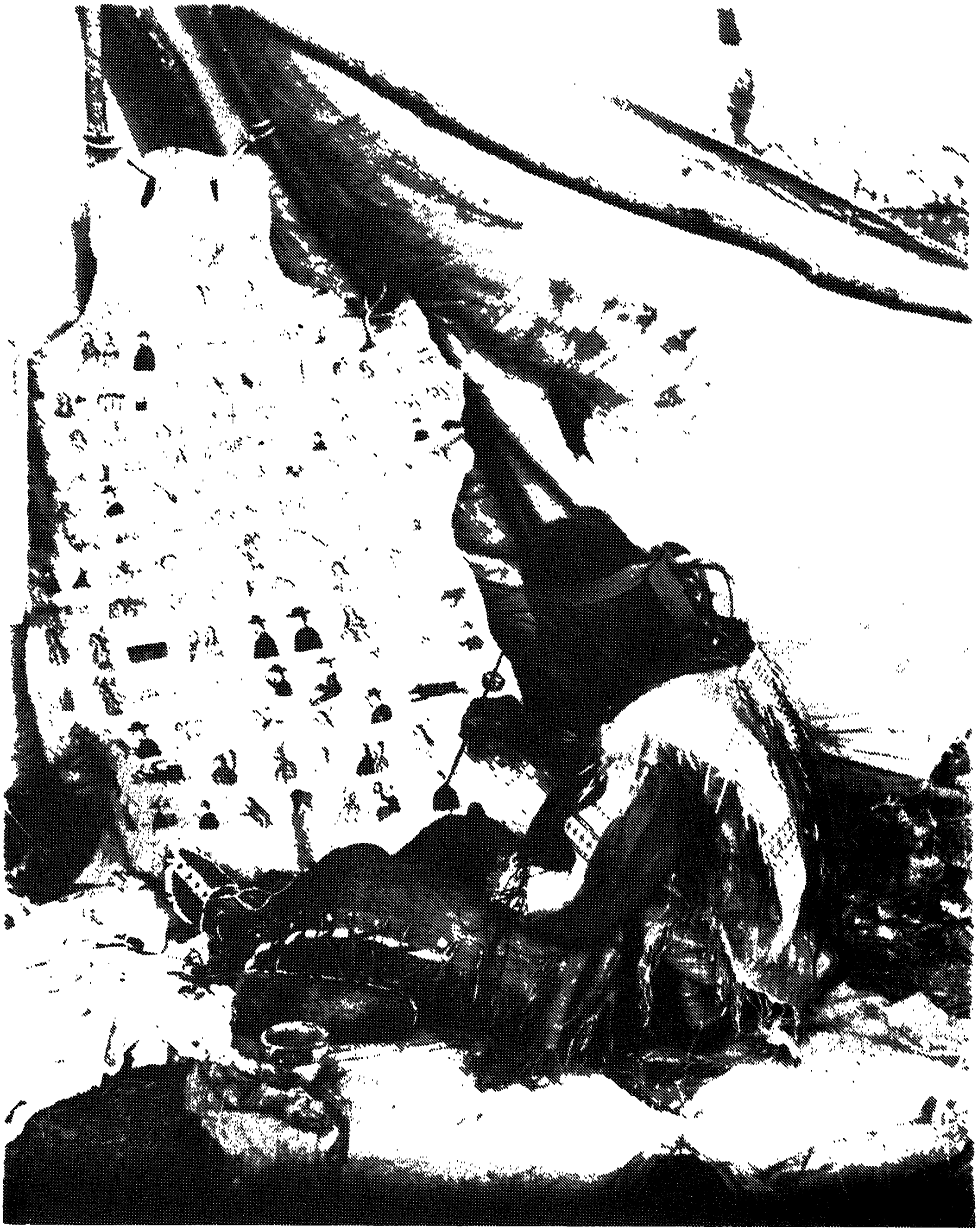

FIG. 1. Kills Two, a Brule' medicine man painting the Big Missouri winter count. Photograph by John Anderson. Courtesy John A. Anderson Collection, Nebraska State Historical Society.

for one could learn the year of one's birth and keep track of one's age and of important personal things by association with the picture chart of years.

As each keeper grew old or ill, the responsibility was transferred to another who learned the required information. Historic practices among the Sioux suggest that it was not uncommon for more than one copy of the count to be extant among the group, each copy being kept current by its owner. We find

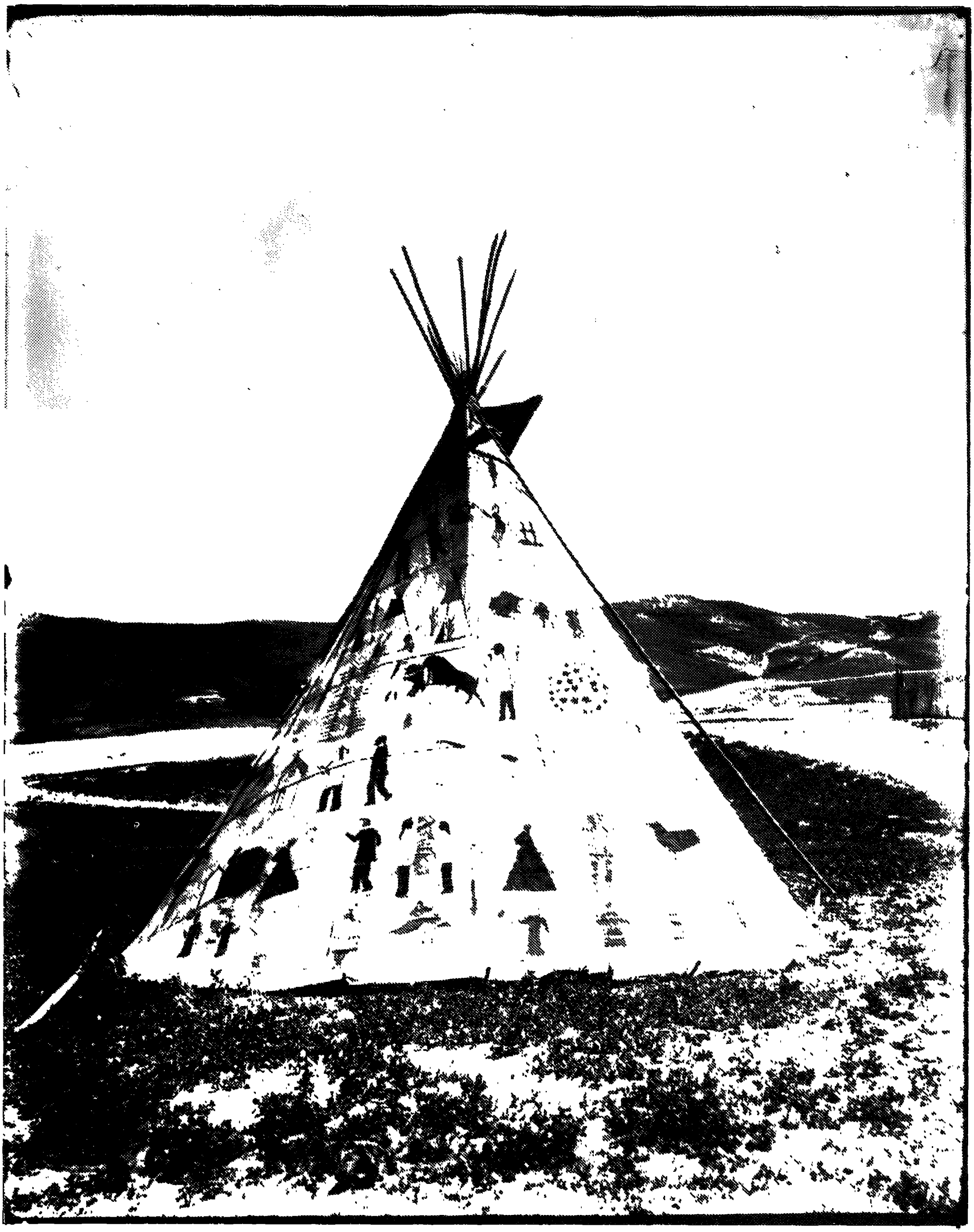

FIG. 2. Brule Tipi Cover winter count. This canvas tipi was reported to have belonged to Chief High Hawk. Courtesy John A. Anderson Collection. Nebraska State Historical Society.

groups of counts which apparently derived from a single count. Thus variations occurred in certain details, such as the picture used to remember any particular year, but the copies of a particular count remained very similar to each other.

Eventually, as European influences continued to encroach upon the lives of the Indians, tanned hides were replaced by muslin, canvas and other fabrics. The counts were copied onto such materials. Copies of the counts were also

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TABLE 1. A summary of possible astronomical information in Plains Indian calendars.

Calendar name	Type	Years	Possible astronomical entries		References
Counts reported to pertain primarily to the Hunkpapa sub-band of Teton Sioux.					
1. Cranbrook	b	1798–1922	1821	Winter that a star was seen and heard in the air.	Praus 1962
			1833	Winter of the falling stars.	
			1903	Saw a large falling star.	
			1909	Evening Star seen in daytime.	
2. High Dog[1]	b	1798/99–1911/12	1821/22	lit., “Star-a-sounding-went-by.” A star or comet fell while it was thundering. Location uncertain.	Howard 1960a, North Dakota State Historical Society n.d.
			1833–34	lit., “Stars shower down.” This year is named ‘Stars-all-moving-Year.’ The falling of the stars in this year is said to have caused great consternation. They feared Great Spirit had lost control over the creation.	
			1888/89	lit., “Moon (or sun) black died.” There was an eclipse of the sun. The sun turned black and died.	
			1903/04	lit., “Star-only one he died.” A star died (disappeared).	
			1909/10	lit., “Star a burning went-along.” There was a comet.	
			1911/12	Children had measles and the same year a star burned up. lit., “Star a burning came the.”	
3. Hunkpapa (unidentified)[2]	b	1798–1905	1821/22	Glyph is obviously fireball.	Robinson Museum n.d.
			1833/34	Glyph is obviously meteor shower.	
			1903/04	Star glyph may be astronomical entry.	
4. Hunkpapa (unidentified)[3]	d	1789–1926	1822	lit., “Star a bellowing passed by.”	South Dakota State Historical Resource Center n.d.
			1834	lit., “Star(s) whirl around.”	
			1870	lit., “Crows thirty they kill. Daylight sun a died.”	
5. Hunkpapa (Vestal’s)	c	1831–1881	1833	Shower of stars.	Vestal 1934
6. Ironhawk	d	1819–1936	1821	lit., “Star a cries out like a buffalo, like thunder, passing along.” A star passed by, bellowing like a buffalo.	McCoy n.d.
			1833	lit., “Star moved around, shooting, like a blizzard.” The stars shot and swirled in the sky.	
7. Jaw	b	1847/48–1889/90	None		Howard 1960a

8. Long Soldier[2]	b	1798/99–1902/03	1821/22	Rock Creek. Time comet fell on ground with loud noise.	Museum of the American Indian n.d.
			1833/34	Star shoots off. Looks like stone when it fell.	
9. No Two Horns	b	1785/86–1921/22	1821/22	A big star gave a loud voice signal from the air.	Howard 1960a, North Dakota State Historical Society n.d.
			1833/34	The stars all changed around the sky.	
10. Old Bull	d	1821–1889	1821	lit., "Star/a/sounding forth/it goes along."	American Philosophical Society n.d.
			1841	lit., "Stars/they fly in every direction."	
11. Swift Dog[1]	b	1798/99–1911/12	1821/22	lit., "Star a sounding came-by."	Howard 1960a, North Dakota State Historical Society n.d.
			1833/34	lit., "Stars shower-down."	
			1888/89	lit., "Moon-black died." Black moon, Sitting Bull's uncle died.	
			1903/04	lit., "One star died."	
			1908/09	lit., "Star-burning a went-along."	
			1910/11	lit., "Star burning came the."	

Count reported to pertain both to the Itazipco (Sans Arc) and Oohenupa (Two Kettle) sub-bands of Teton Sioux.

12. The Flame	b	1786/87–1876/77	1821/22	Large ball of fire with hissing noise (aerolite).	Mallery 1886, 1893, n.d.
			1833/34	Many stars fell (meteors).	
			1869/70	Eclipse of the moon.	

Counts reported to pertain primarily to the Miniconjou sub-band of the Teton Sioux.

13. Bush	b	1800/01–1869/70	1821/22	Saw a very large meteor going S.E. to N.W.	Mallery 1886, 1893, n.d.
			1833/34	Witnessed a magnificent meteor shower, scared nearly to death.	
			1869/70	Great eclipse in August.	
14. Lone Dog	a	1800/01–1870/71	1821/22	The character represents the falling to earth of a brilliant meteor.	Mallery 1877, 1886, 1893, n.d.
			1833/34	The stars fell.	
			1869/70	An eclipse of the sun.	
15. Mato Sapa	b	1800/01–1868/69	1821/22	Sioux saw an immense meteor passing from southeast to northwest.	Mallery 1886, 1893, n.d.
			1833/34	Sioux saw meteoric shower, much frightened.	
			1869/70	An eclipse of the sun.	
16. Roan Bear	d	1784–1952	1819	lit., "Star a sounding came by." A meteor fell to earth making a loud noise.	Howard 1955
			1832	lit., "Stars moved around" or "Stars falling down."	
			1869	lit., "Morning-sun a died."	
			1910	lit., "Star-tail_____a_____."	

TABLE 1—*continued*

Calendar name	Type	Years	Possible astronomical entries	References
17. The Swan	a, b	1800/01–1870/71	1821/22 Sioux Indians saw an immense meteor passing from S.E. to N.W. exploded with great noise (in Dakota Territory). 1833/34 Sioux witnessed magnificent meteoric showers; much terrified. 1869/70 Sioux witnessed eclipse of the sun; frightened terribly.	Mallery 1886, 1893, n.d.
Counts reported to pertain both to the Miniconjou and Hunkpapa sub-bands of Teton Sioux.				
18. Charging Thunder	b	1761–1900	1821/22 Glyph is obviously fireball. 1833/34 Glyph is obviously meteor shower.	Robinson Museum n.d.
19. White Bull (Howard's)[4]	d	1764/65–1930/31	None[4]	Howard 1968
20. White Bull (Vestal's)[5]	d	1781–1816, 1833–1932	1833 The stars move.	Vestal 1934
Counts reported to pertain primarily to the Oglala sub-band of the Teton Sioux.				
21. American Horse	c	1775/76–1878/79	1833/34 The stars moved around.	Mallery 1886, 1893, n.d.
22. Ben Kindle	e	1759–1925	1821 lit. "Star/a/with voice/it went by." A shooting star flew from east to west with a noise like thunder. 1833 lit. "Stars/they go in all directions." The way the stars seemed to fly in every way looked like snow coming down. Stars change places, *i.e.*, there are many shooting stars seen in the heavens.	Beckwith 1930, Turner 1973
23. Cloud Shield	c	1775/76–1878/79	1821/22 A large roaring star fell. It came from the east and shot out sparks of fire along its course. Its track, and the sparks are shown in the figure. Red Cloud was born. 1833/34 It rained stars.	Mallery 1886, 1893, n.d.

24. Flying Hawk	d	1759–1906	1821	When the moving star sounded.	McCreight 1947
			1833	When the stars were shooting.	
25. Garnier (Little Bat)	d	1759–1908	1821	A moving star roared.	Grange 1963
			1833	The stars fell.	
26. Iron Crow	d	1785–1901/02	1821	lit., "Star one roars passed-by." Falling star that made a noise.	American Museum of Natural History n.d., DeMallie 1982
			1833	lit., "Stars shoot altogether winter." When the stars fell.	
27. John Colhoff (Whiteman Stands in Sight)	d	1759–1896	1821	lit., "Star a producing a voice it goes came." A roaring, shooting star rose from the east and west seen by the Oglalas.	Powers 1963
			1833	lit., "Star it storms." Shooting stars like snow flakes in a storm.	
28. No Ears	d	1759–1918	1821	Echo of a sounding star.	Howard 1960c, DeMallie 1982
			1833	Shooting of the stars.	
29. Oglala (unidentified)	d	1759–1919	1821	A moving star roared.	National Anthropological Archives n.d.
			1833	The stars fell.	
30. Oglala (unidentified)	d	1759–1906	1821	lit., "Star/a/crying out/he goes along." The star that made a noise as it cut through the air.	American Philosophical Society n.d.
			1833	lit., "Stars/they fly in all directions."	
31. Red Horse Owner[6]	c	1786–1968	1833	Meteor shower.	Karol 1969
			1966	Leonid Meteor Shower was seen in Rapid City, Thursday morning in Allen.	
32. Short Man	c	1821–1923	1822	lit., "Star a roars comes-by". A roaring star passed.	American Museum of Natural History n.d., DeMallie 1982
			1833	lit., "Stars shoot altogether." All the stars shoot together.	
			1888/89	From AMNH: lit., "Night sun a died." The moon eclipsed. From DeMallie: Eclipse of the sun.	
33. White Buffalo Man[7]	d	1850–1906	None		Howard 1960c
34. White Cow Killer	c	1775/76–1878/79 (?)	1821/22	One-star-made-a-great-noise Winter.	Mallery 1886, 1893
			1833/34	Plenty-stars Winter.	
35. Wounded Bear	c	1815/16–1896/97	1821/22	A star burst loudly and went on. Red Cloud, whose name is better translated as Scarlet Sky, was born this year and named for this meteor sighting.	Feraca 1974, n.d.
			1833/34	Many stars fell.	

TABLE 1—*continued*

Calendar name	Type	Years	Possible astronomical entries		References
Counts reported to pertain primarily to the Sicangu (Brule') sub-band of Teton Sioux.					
36. Battiste Good[8]	c	1700–1910	1821/22	Star-passed-by-with-loud-noise Winter. In the figure the meteor, its pathway and the cloud from which it came are shown. Red Cloud was born.	Mallery 1886, 1893, n.d.
			1833/34	Storm-of-stars Winter.	
			1894	Glyph resembles a fireball[7].	
37. Big Missouri	b, a	1796–1926	1834	The winter the stars fell.	Cohen 1939, Cheney 1979
			1870	The winter the sun eclipsed.	
38. Brown Wolf	c	1835–1921	1835	Glyph is obviously meteor shower.	Robinson Museum, n.d.
39. Brule' Tipi Cover	b	1788/89 (?)–1865/66 (?)	1833	Glyph is obviously meteor shower. No other astronomical glyph visible on existing photographs.	Dyck 1971
40. Hardin	b	1776/77–1878/79	1821/22	Star passed by with loud noise.	Finster 1968
			1833/34	Storm of stars.	
41. High Hawk[9]	a	1701–1907	1822	A falling star.	Curtis 1908
			1834	Moving stars.	
			1894	Falling stars.	
42 Iron Shell	d	1807–1883	1821	Whistling star.	Hassrick 1964
			1833	Shifting stars.	
			1869	The Sun Died.	
43. Short Bull	c	1830/31–1918/19	1833	Glyph is obviously meteor shower.	Sioux Indian Museum n.d.
44. Swift Bear[10]	b	1800/01–1898/99	1821/22	A-big-noisy-star-passed Winter. The streaks show that it let off particles of light in its passing. Red Cloud was born this winter.	Cohen 1942, Robinson Museum n.d.
			1833/34	Many-stars-fall Winter. The circle represents a lodge or Tipi with a shower of stars over or around it.	
Counts reported to pertain primarily to the Yanktonai Middle Sioux.					
45. Blue Thunder	b	1785/86–1921/22	1821/22	In Montana. Three Buttes going for Winter. Big Star went along making a great noise.	Howard 1960a
			1833/34	Stars flew around like bird. Many stars with great noise. Changed places winter.	

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46. Blue Thunder (Variants I and II, two counts)	b	1785/86–1912/13	1821/22 1833/34	In Marten (Butte) Big Star made loud noise. Camping across River and Many stars fell with noise a few on earth.	Howard 1960a, North Dakota State Historical Society n.d.
47. Yellow Lodge (Blue Thunder Variant III)	b	1785/86–1930/31	1821/22 1833/34	Glyph is obviously fireball. Glyph is obviously meteor shower.	North Dakota State Historical Society n.d.
48. John K. Bear	d	1682–1883	1741 1834	A buzzing (humming) noise heard throughout the land. The falling of the stars.	Howard 1976
49. Wind-Roan Bear	d	1796–1885	1832 1833 1910	lit., "Stars moved-around." Falling stars. Stars seen to come from all directions. A comet appears in the sky.	Higginbotham 1981, Howard 1955
50. British Museum	b	1785/86–1901/02	1821/22 1833/34	Star a sounding passed-by. The-falling-of-stars.	Howard 1979
Counts reported to pertain to the Mandan and Hidatsa Indians.					
51. Butterfly	d	1833–1876	1833/34	One summer, many years ago many stars fell down to the ground.	Howard 1960b, Smith 1960
52. Foolish Woman	c	1835–1870	1835	Shooting stars fell during the summer.	Beckwith 1937
Counts reported to pertain to the North Blackfoot Indians.					
53. Houghton Running Rabbit	d	1830–1937	1834 1869	The Stars fall down. Small pox years! Three Sun died.	Glenbow Museum, n.d.
54. Teddy Yellow Fly	d	1830–1937	1835	The year the stars fell.	Glenbow Museum n.d.
Count reported to pertain to the Blood Indians.					
55. Bad Head[11]	e[11]	1810–1883	1833	Stars/when they fell.	Dempsey 1965
Counts reported to pertain to the Peigan Indians.					
56. Bull Plume[12]	c	1770 or 1764–1924	1781 or 1783 1795 or 1788 1832 or 1833 1864 or 1863 1889 or 1888 1911 or 1908	Eclipse of Sun in Winter. Winter when the stars fell. When lots of stars fell. Eclipse of Sun in summer. Eclipse of Moon. Comet.	Glenbow Museum n.d., Raczka 1979
57. Big Brave	e	1846 (?)–1908	None		Wissler 1911
58. Elk Horn	e	1845–1890	None		Wissler 1911

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TABLE 1—*concluded*

Calendar name	Type	Years	Possible astronomical entries		References
Counts reported to pertain to the Kiowa Indians.					
59. Ah-nan-ti (White Bear)	c	1833–1921	1833	Stars fell. (winter)	Fort Sill Museum n.d.
			1878	Repeated Sun dance and the Sun was died. (summer)	
60. Anko (yearly)[13]	c	1864–1892	None		Mooney 1898
61. Anko (monthly)[13]	c	Aug. 1889–July 1892	November 1891.	Total lunar eclipse	Mooney 1898
62. Dohasan[13]	c	1833–1892	1833	Winter that the stars fell.	Mooney 1898
63. George Hunt[14]	?	1826–1900/01	1833/34	The winter the stars fell.	Marriott 1945
			1878	Double sun dance. Eclipse of the sun during the dance.	
64. George Poolaw[14]	?	1832/33–1900/01	1833/34	The winter the stars fell.	Marriott 1945
			1874	Western migration of part of the tribe under Plenty Stars.	
65. Jimmy Auchiah	c	1851–1934	1918	In summer an eclipse of the sun. No crops growed and no rain. Fremont's wife died Mother of Henrietta.	Fort Sill Museum n.d.
66. Jimmy Quetone[15]	c	1827–*c.* 1920	1833	Stars fell.	Fort Sill Museum n.d.
67. Kiowa (unidentified)	c	1832/33–1867	1833/34	The stars fell (winter).	Fort Sill Museum n.d.
68. Mary Buffalo[14]	?	1832/33–1900/01	1833/34	The winter the stars fell.	Marriott 1945
69. Set-t'an[13]	c	1833–1892	1833/34	Winter that the stars fell.	Mooney1898

FOOTNOTES

1. Howard listed the High Dog and Swift Dog counts beginning with the year 1797/98, but McCoy has informed me (private correspondence) that they both begin with the year 1798/99.
2. McCoy has noted (private correspondence) that the Hunkpapa (unidentified) count from the Robinson Museum and the Long Soldier count at the Museum of the American Indian appear to be copies of the same winter count except that the former runs three more years than the latter.
3. Translations for entries for the Hunkpapa (unidentified) count from the South Dakota State Historical Resource Center, a Lakota text, were supplied by McCoy through private correspondence.
4. Howard's White Bull count contains no entries for the years 1817/18 to 1834/35, an interval which includes the two most often cited astronomical events, the ones for 1821/22 and 1833/34.

5. Vestal's White Bull count contains no entries for the years 1817 to 1832, an interval which includes the often cited fireball event for 1821/22.
6. The Red Horse Owner count was being kept up to date at the time of publication of the paper cited as the reference source. Therefore, it was kept to at least 1968 and possibly longer.
7. The White Buffalo Man count is an interesting transition type; it is an Indian language text (no pictographs) kept on muslin instead of the usual transition to paper.
8. The author is aware of three copies of the Battiste Good count: the facsimile drawn by Battiste Good, used by Mallery in his publications; a copy (probably the original) at the Sioux Indian Museum in Rapid City, SD; and a copy at the Denver Art Museum. The copy used by Mallery ends with the 1879/80 glyph, but the Rapid City copy continues to 1910. The glyph for 1894 resembles a fireball, but there is no interpretation for the count from 1880 through 1910. For interpretation of these additional years, we can turn to the High Hawk count, since High Hawk was Battiste Good's son. High Hawk's name appears on the final pages of the Sioux Indian Museum copy, indicating that High Hawk made the final entries. McCoy has noted (private communication) that Mallery's and Good's understanding of the chronology differed by one year: Good labelled the first year 1701, which resulted in the meteor shower being labelled 1834, and Mallery published all the entries as being one year earlier than Good's entries. Mallery probably re-adjusted the count based upon his knowledge of the date of the meteor shower.
9. McCoy has pointed out (private correspondence) that even though the High Hawk count published by Curtis ends in 1900, the count continued to 1907. This is revealed by a photograph in McCoy's possession.
10. Howard (1960a) indicated that this count, consisting of pictographs on a black-tailed deer hide, was located at the Bureau of Indian Affairs offices in Washington, DC. The author has been unable to locate such an artifact, but he did locate a copy of the Swift Bear count with pictographs on both sides of a strip of muslin at the Robinson Museum in Pierre, SD.
11. The Bad Head count is reported originally to have been pictographs on tanned hide, but only the memorized year-names were collected and recorded. Dempsey (1965: 4) mentioned another Blood winter count in his possession, the Jim White Bull count, which he said contains much of the Bad Head count, but continues to 1906.
12. Two copies of the Bull Plume count are known to the author. Apparently both originated from the same source, a journal of W. R. Haynes who copied the count when Bull Plume took it to him for translation into English. Dates on the copy in the archives of the Glenbow Museum differ from those published by Raczka. According to Raczka, Haynes's original journal found its way to the Fort Macleod Museum where it remains today. Raczka decoded the dating system, which differs from the dates on the copy at the Glenbow Museum. Since neither dating system seems to fit the astronomical information, both dates are entered into Table 1 with the Glenbow dates first followed by Raczka's dates.
13. Mooney's publication includes a photograph of the Set-t'an calendar. He does not show the Dohasan calendar, but states that it is nearly identical to Set-t'an. The original Anko calendars, both yearly and monthly, were recorded in a notebook, but were redrawn on buckskin by Anko under the direction of Mooney. This reproduction is shown in Mooney's publication.
14. Marriott does not state whether or not the calendars she recorded were pictographic. Also, the ending years seemed to have been cut off at 1900/01 by her choice. She stated, for example, that George Poolaw continued his count until his death in 1939.
15. Howard (1979: 116) lists this under the name Au-zah-te, but information from the Fort Sill Museum indicates that a more appropriate identifying name is Jimmy Quetone.

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made to give or sell to collectors who came among the people. Then missionaries and others helped some Indians to develop written languages and paper became common among Indians. So the winter counts were transferred to ledgers, notebooks or other paper sheets. In many cases the pictographs were dropped and only the year-names were recorded.

At the time of this study, more than seventy calendars of these types are known, usually named for their last known official keepers. New ones turn up in old trunks or museum drawers from time to time. Only a few of what we can think of as the early forms have survived. Most winter counts seem to be copies of a few primary counts, each copy having some unique features. Some of the copies we have are known to have been made by Indians for white scholars or collectors and of these some were carefully made facsimiles while others were probably not so accurately copied. We find them, then, existing in the following forms: on animal skins; on muslin, canvas and other fabric; on paper in notebooks, ledgers, journals and various and sundry sheets. Interestingly, one (the Wounded Bear count) was drawn on a US Army deserters form. Plates 1–7, Figures 1 and 2 and Table 1 indicate the range and variety.

The winter counts contain information about all aspects of Indian life: religion, politics, social activities, hunting and other forms of subsistence, suicides and homicides, warfare and other cultural contact, disease, inter-tribal relations, quality of life, hard and good times, technological change, cultural change, folklore, material culture, climatic conditions and response to natural phenomena. The pictographs, on the counts still showing them, include depictions of: humans, ways in which people were injured or killed, scalps, articles of clothing, ceremonial implements, flags, weapons, glyphic names of persons, animals, plants, tipis and other types of living quarters, and geological, meteorological and astronomical phenomena.

Another somewhat similar approach to keeping a chronological tribal record was common among the Pima and Papago Indians of the American Southwest. Instead of animal skins, these Indians used sticks to inscribe symbols representing events to remember the years. Similar to others known elsewhere in the world, the Pima stick calendars have been described by Russell (1908: 34–66), who noted that the keeper could recite events of any particular year by simply running his thumb nail along the marks representing the years. Examples of Pima calendar sticks from the collection of the US National Museum of Natural History, one of which begins with the 1833 Leonid meteor shower, are shown in Plate 8. Russell (1908: 35) also noted that the Santee Sioux were reported to have used notched sticks to represent their history for more than 1000 years. Pima, Osage and Winnebago calendar sticks are in the collection of the Museum of the American Indian in New York City. Hassrick (1964: 11) wrote that, in addition to the annual winter count system, the Sioux had methods for counting months and days. He described the use of a notched stick:

> In the evenings, when the moon first rose, Iron Shell made a nick in a long pole he kept by the bed for that purpose. Every night he made another nick, until the moon finally disappeared. Then he said "The Moon Died". There were usually 25 or 26 nicks for each month, for there are three days when the moon cannot be seen. On the other side of the pole, Iron Shell marked a single nick to show the passing of a month.

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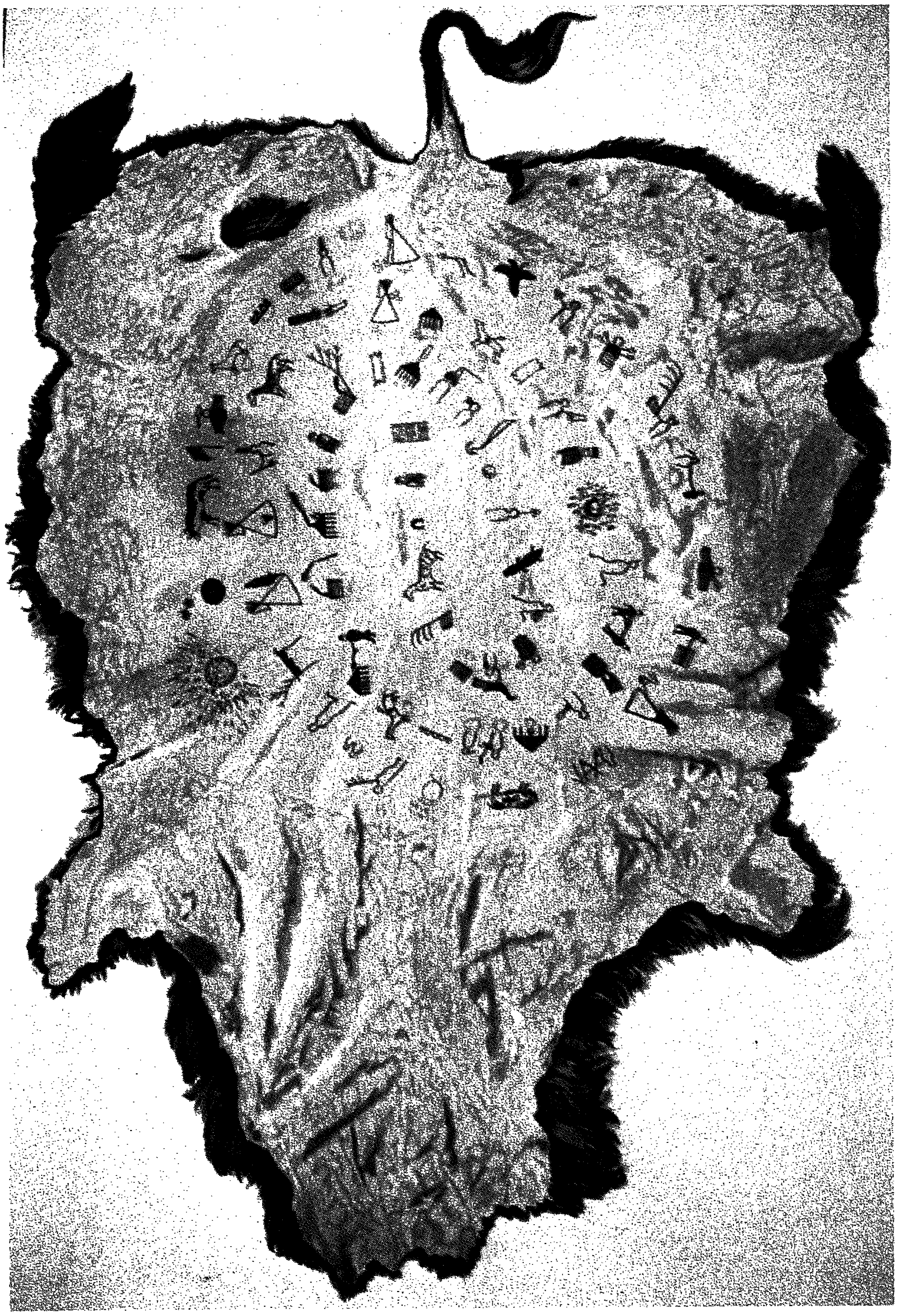

PLATE 1. Mallery's (1877, 1886 and 1893) reproduction of the Lone Dog winter count made to show how the count appeared on a buffalo robe kept in Lone Dog's possession. This reproduction was made from a copy on cotton cloth rather than directly from Lone Dog's copy on buffalo hide. The count begins in the centre with the year 1800/01 and spirals outward to end with the year 1870/71 at the top left. A photograph of a copy of this count is found in *Archaeoastronomy*, no. 1 (1979), p. S19, plate 4.

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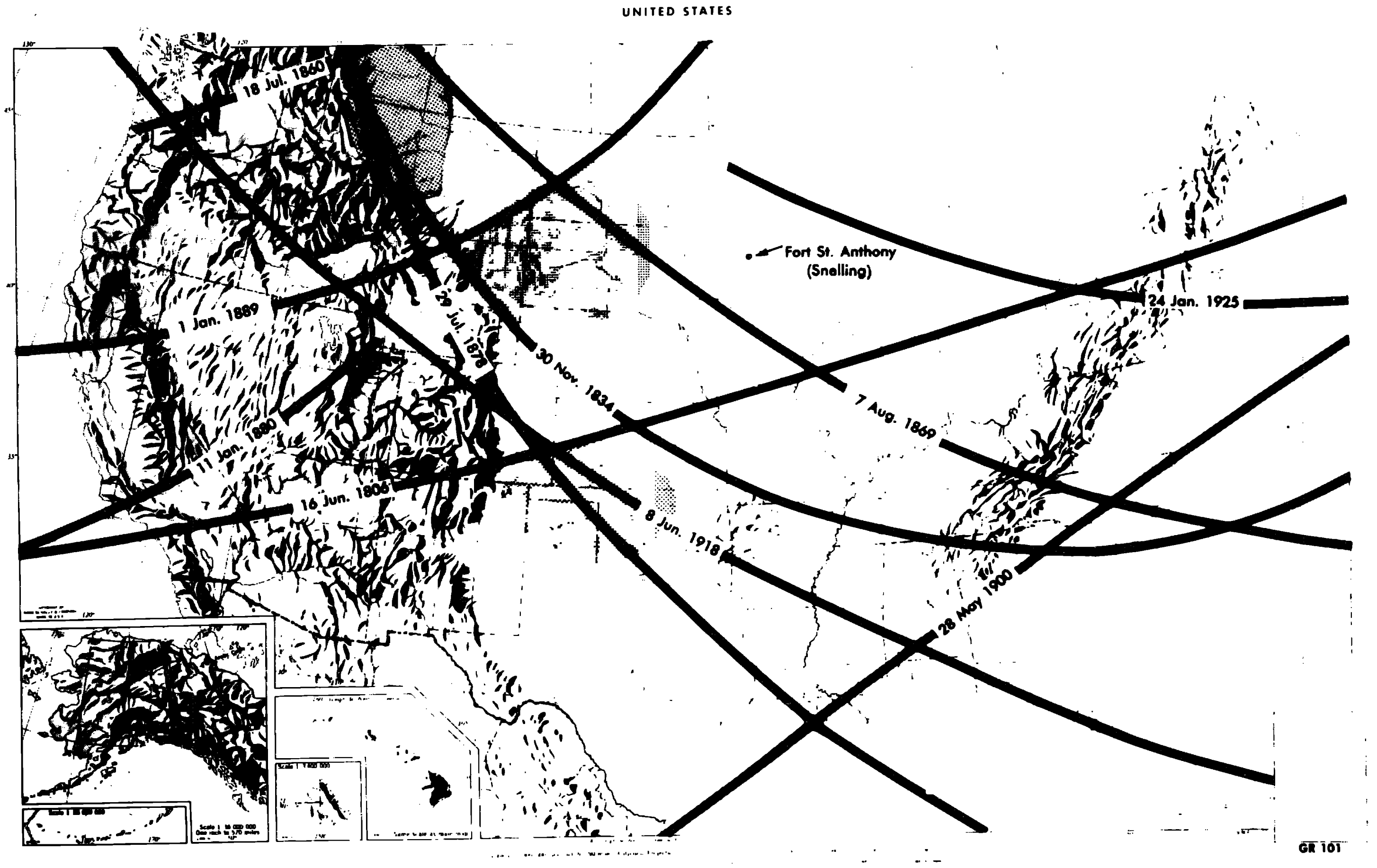

FIG. 3. Regions of occupation of the Sioux, Blackfoot and Kiowa during the epochs of the winter counts. State boundaries are shown for reference. Eclipse paths discussed in this paper are shown and the location of Fort St Anthony, also known as Fort Snelling, is indicated.

> Iron Shell carried this stick wherever he went. He got a new stick each year, cutting it in the moon of the Birth of Calves.

DeMallie (1982: 122–123) discussed the Oglala Sioux divisions of time including the names they used for months, and Wissler (1912: 45) described how the Blackfoot Indians used pebbles and painted sticks for counting days and lunations. Thus, it appears that winter counts were only one part of more elaborate chronological systems.

Obviously we must approach the interpretation of winter counts and similar artifacts with great caution and make conclusions sparingly. Once the counts gained notoriety, they were copied by Indians and Whites alike. Study of the counts and their histories makes it obvious that groups of them are copies of each other with variations produced by their authors, who copied primary counts, then individualized them. However, the various known counts show remarkable agreement when compared with each other (Howard 1960a: 340). There is an impressive literature on winter counts and their interpretations. It is not our purpose here to recount what is already in the literature, but rather to pick out the entries which deal with astronomical events, list and summarize them and analyse their significance.

THE CALENDARS

Table 1 lists the 69 calendars used in this study and summarizes the year-events of possible astronomical interest. Not all known calendars were included. Information was lacking on a few of them and one, known as the Jaw Variant, does not appear to be an actual calendar. Before proceeding to discuss each astronomical event, basic information shown in the columns of the table will be clarified.

The table is organized into sections which present the calendars arranged by cultural groups and sub-groups to which they are reported to pertain. It should be noted that some of the counts apparently pertain to more than one Indian group, sometimes several. They are grouped here according to their *primary* cultural associations. The calendars come from the three geographical areas shown in Figure 3: the central plains, now southeastern Montana, northeastern Wyoming, northwestern Nebraska, western South Dakota and southwestern North Dakota, still occupied by the Teton and Yanktonai Sioux; the upper plains, now parts of northern Montana, southeastern Alberta and southwestern Saskatchewan, occupied by the Blackfoot; the lower plains, now parts of southeastern Colorado, southwestern Kansas, northern Texas and northwestern Oklahoma, occupied by the Kiowa.

Most of the year counts come from the Indians generally known as the "Sioux". Terminology referring to the sub-divisions of these people found in anthropological literature is quite confusing. Here we will break them down into: (1) the Eastern Sioux, or Santee, speaking the Dakota dialect; (2) the Middle Sioux, or Yanton and Yanktonai Sioux, speaking the Nakota dialect; and (3) the Western, or Teton Sioux, speaking the Lakota dialect. Some anthropologists prefer to refer to all three groups as the Dakota. There are no winter counts from the Eastern Sioux in this study.

The Teton Sioux, from which the majority of the winter counts come, were composed of seven bands: (1) the Hunkpapa, a name meaning "camp by the

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PLATE 2. The Charging Thunder winter count, on a large piece of cloth, from the South Dakota State Historical Society's Robinson Museum in Pierre, South Dakota. Only part of the count shows in this photograph by the author. It begins on the outside with the year 1761 and spirals to the centre where it ends in 1900.

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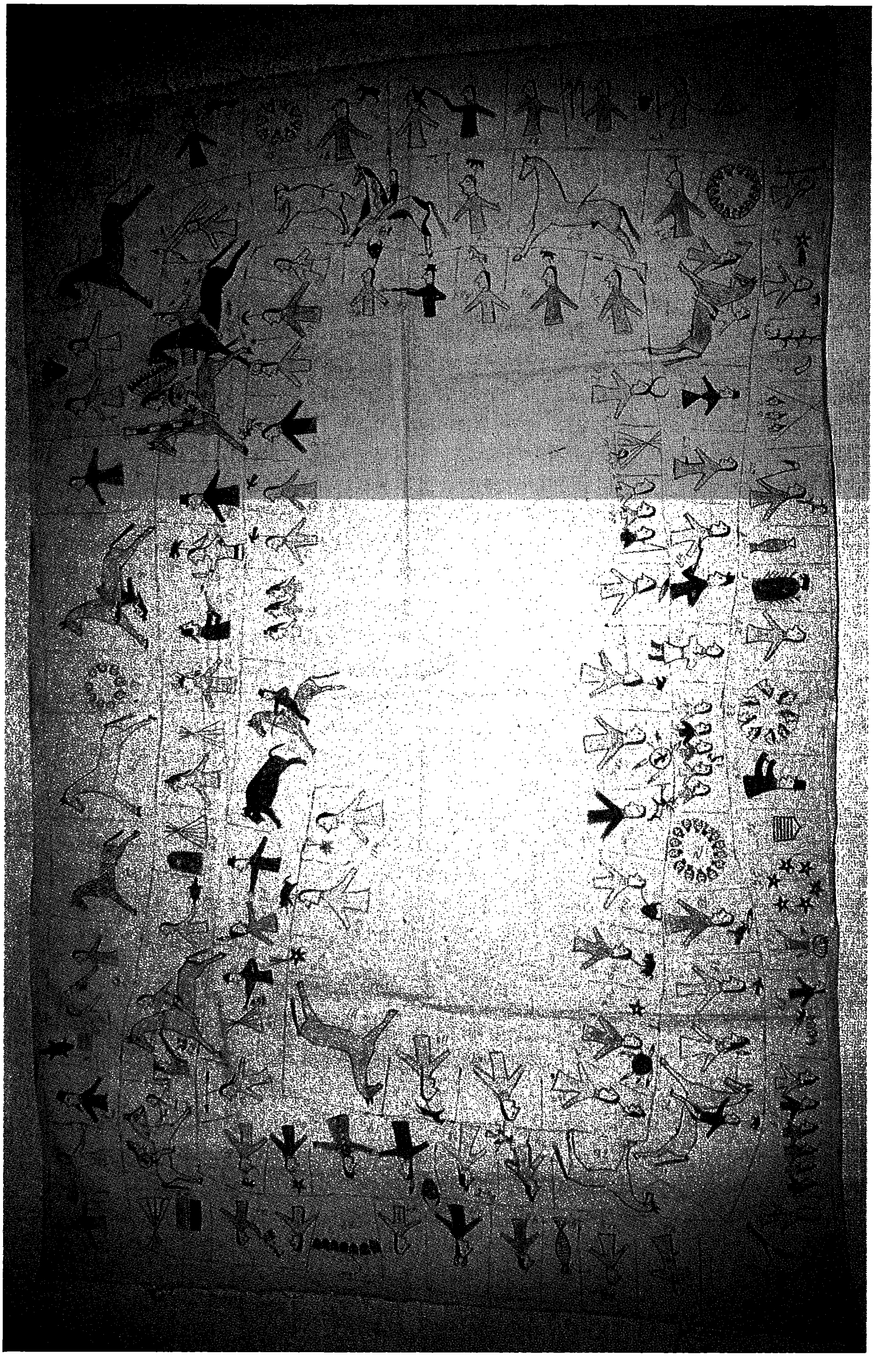

PLATE 3. The High Dog winter count, on cloth, at the North Dakota State Historical Society in Bismarck, North Dakota. The count begins with the year 1798/99 at the upper left and spirals inward ending in 1911/12. Photograph by the author.

entrance"; (2) the Itazipco, or Sans Arcs, meaning "without bows"; (3) the Miniconjou, "plant by the stream"; (4) the Oglala, "scatters one's own"; (5) the Oohenupa, "two boilings" or "two kettles"; (6) the Sicangu, or Brule', "burnt-thighs"; (7) the Sihasapa, or "Blackfoot", not to be confused with the tribe known as Blackfoot. The Teton winter counts are listed first in Table 1. It should be noted that the winter counts listed as Hunkpapa generally pertain strongly to the other northern Teton sub-bands (Itazipco, Miniconjou, Oohenupa, Sihasapa) as well.

Only a few of the Sioux counts come from another band, the Yanktonai band of Middle Sioux. These are listed in Table 1 following the Teton counts.

Next come two winter counts from the Mandan and Hidatsa Indians living just to the north of the Sioux, and following these are counts from several Blackfoot groups: the North Blackfoot, Blood and Peigan Indians.

Finally there are several year counts from the Kiowa Indians. These cannot be technically called winter counts, since they contain two entries for each year; one for the summer season and one for winter. One of them, known as the Anko Monthly calendar, consists of entries for each month from August 1889 to July 1892. Mooney (1898: 144) mentions a Kiowa calendar, thought to date back farther than the others, kept by a Kiowa Apache named Polanyikaton and which was supposed buried with its author. No details are known about this calendar and it is not included in Table 1. Howard (1979: 115–16) lists several Kiowa calendars (Au-zah-ti, An-an-ti no. 1, An-an-ti no. 2, Gaukey) as being at the Fort Sill Military Museum. I was unable to confirm the identity of all of these with the inclusive year dates indicated by Howard, but did find four Kiowa calendars at Fort Sill. One of these is apparently the one Howard called Au-zah-ti: it is listed as Jimmy Quetone in Table 1. Another was labelled Ah-nan-ti and was shown to run from 1833 to 1921, inclusive years which do not agree with either of the calendars Howard calls An-an-ti. It is listed as Ah-nan-ti in Table 1. Still another is listed as Jimmy Auchiah. The remaining calendar at Fort Sill, running from 1832/33 to 1867, was in a ledger book and the author was not documented. It is included in Table 1 as "Kiowa (unidentified)". Since I was unable to get definitive information on the calendars Howard listed as An-an-ti nos. 1 and 2 and Gaukey, these have not been entered into Table 1.

Throughout the remainder of this paper, the sequential listing numbers of calendars from Table 1 will be shown in parentheses immediately following most references to the names of calendars or information cited from them. This will assist readers in quickly locating calendar entries in the table.

The second column of Table 1 indicates the form in which the year counts became known to scholars as follows: (a) pictographs on animal hide; (b) pictographs on fabric (muslin, canvas, cloth); (c) pictographs on paper (journals, notebooks, ledgers, sheets); (d) Indian language and/or English text of year events, with or without English translation, handwritten or typed, usually on paper; and (e) oral information given from memory. It should be noted that type (a) counts may or may not be 'old' artifacts. Indeed, many of those in existence are recently produced facsimiles or, sometimes, copies from counts first known on fabric or paper put on skins in an attempt to simulate them in the form considered by those making the copy to be the 'proper' form

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for a winter count. Type (b) counts frequently contain notes inscribed in Indian languages and/or English next to the year glyphs. These are usually the year-names and/or year numbers. Some of these notes were made by the Indians and some were added by scholars who studied the counts. Type (c) counts also frequently contain notes next to the glyphs and elsewhere on the sheets and some of these were added after the copies were made by, or under the direction of, Indians.

The third column of the table shows the range of years reported to be included in the counts, while column four lists the years of possible astronomical interest along with literal translations of year-names, where they are known, and interpretive meanings of these names. Most of this information comes from published literature and archival manuscripts which interpret the counts. Some counts, however, have no interpretations accompanying them, either published or archival; yet it is clear, by comparison with other counts, that certain pictographs are astronomical entries. They are noted as such in column four. In a number of cases the information sources list the wrong years for some events. In most of these the error is clear and needs no comment. Where clarification is needed, it will be made in the appropriate sections to follow.

The final column indicates the sources of information on each year count. Some of the counts used in this study have not been published and the author was able personally to study many winter count artifacts relating to both published and unpublished counts. He also had occasion to examine some archival manuscripts which improved the information reported here over what it would be if only published information were used. A case in point is the several very similar winter counts published by Mallery: Lone Dog (14), The Swan (17), Mato Sapa (15), American Horse (21), Bush (13) and The Flame (12). In his publications Mallery was not always clear about specific year entries from each of the counts. His manuscripts and unpublished materials kept at the National Anthropological Archives contain information and marginal notes which clarify the counts. Included are interpretations of each of the counts made by various people who acquired and translated them. These were valuable for determining information to use in Table 1. (Readers may note that these entries do not agree exactly with the information published by Mallery.) When archival information is used, it is noted under references in Table 1. Detailed references are found at the end of the paper.

THE ASTRONOMICAL YEARS

To start our examination of the astronomical entries in the calendars, let us raise the question, what astronomical events might we expect to find recorded in the counts? Will we find novae and supernovae? Eclipses of the Sun and Moon? Comets? Fireballs? Meteors and meteor showers? Will we find spectacular groupings of planets; occultations of Venus, the other planets or the stars by the Moon; the appearance of naked-eye sunspots; or transits of Venus across the solar disk? Might we even find such things as the maximum northern and southern risings or settings of Venus or the other planets? By their very nature, the counts consist of year entries of great significance to the people who made them. Each entry concerned something which was of fundamental

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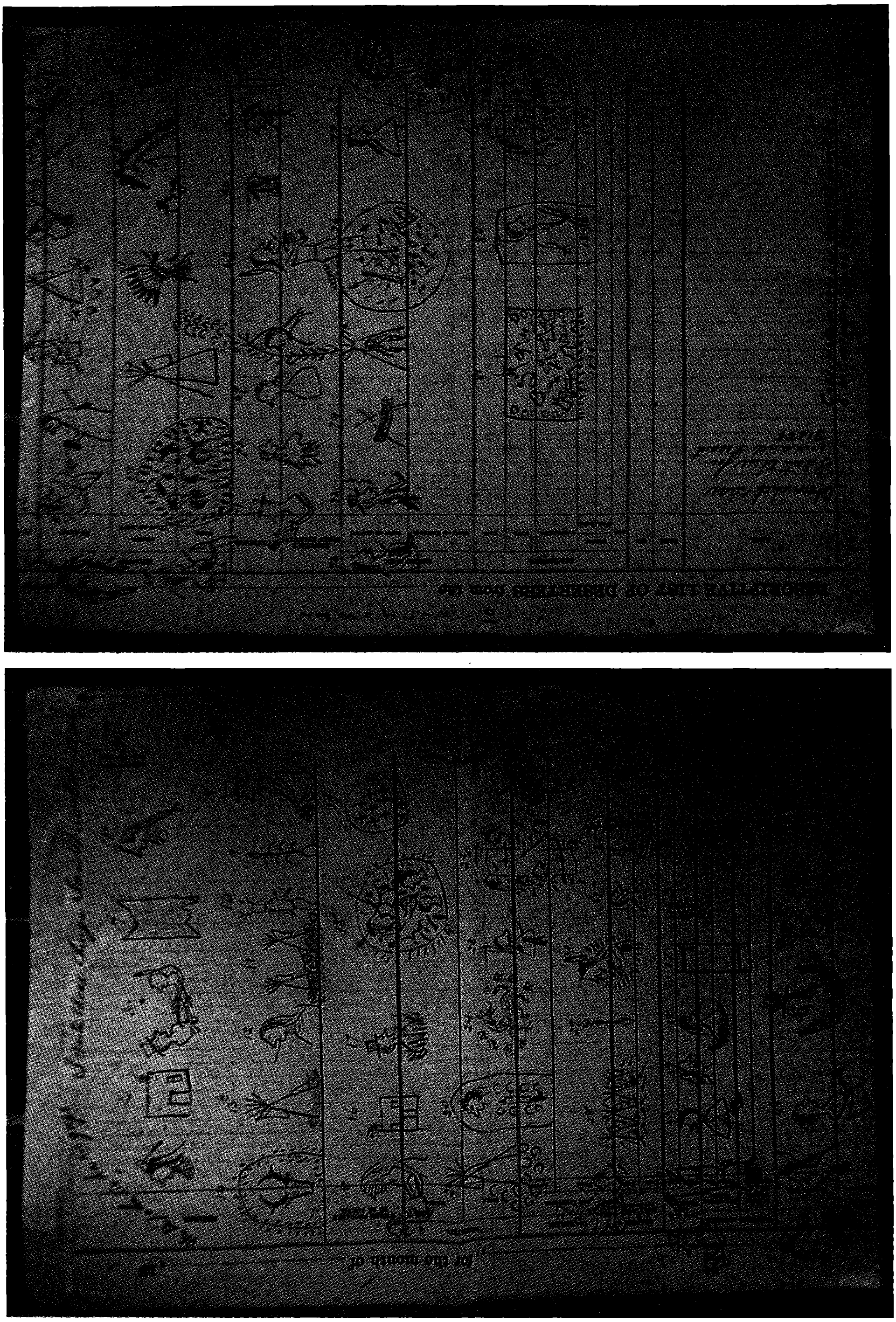

Plate 4. The Wounded Bear winter count, on a US Army deserters form, split here into two parts with the top at left and bottom at right. It begins with 1815/16 (top left), weaving back and forth across the sheets, and ends in 1896/97 (bottom left). Photographs by the author of a copy in the possession of Stephen E. Feraca.

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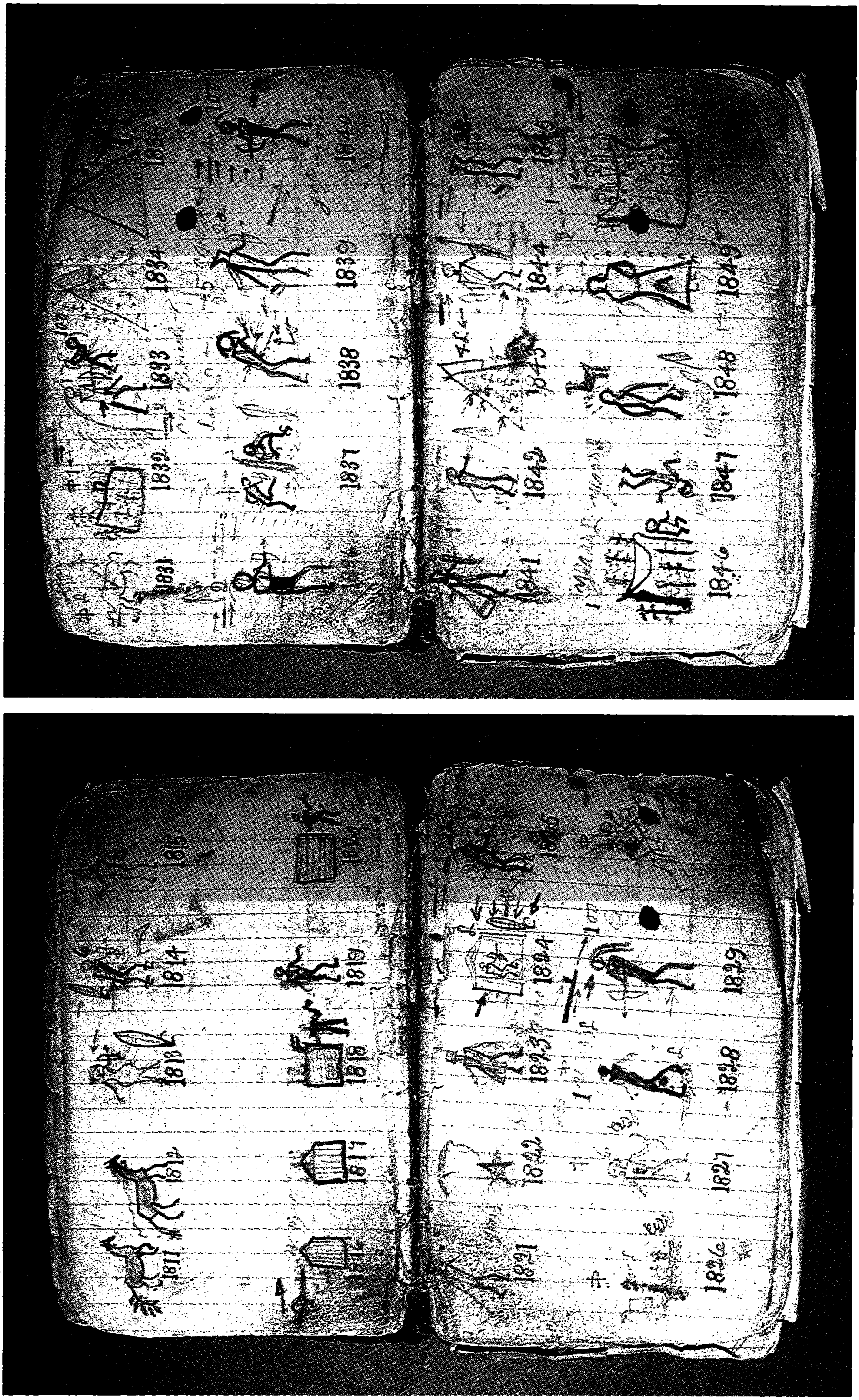

PLATE 5. Four pages from the copy of the Battiste Good winter count at the Sioux Indian Museum in Rapid City, South Dakota. This ledger is probably the original copy of the Battiste Good count. Photographs by the author.

importance to the group. It is not surprising, then, to find that most entries pertain to the deaths of important people, to climatic conditions, warfare with other groups, or political affairs. It is interesting to note that events involving both Indians and Whites which the latter considered to be of great significance were apparently not so highly regarded by the Indians: even though they appear in our history books, they may not be found in the winter counts. The most notable example of this is the fact that the Sioux winter counts do not even mention the Battle of the Little Big Horn. To be included in the counts, events in the sky would necessarily be of *great* importance to the Indians. This means that they would be very spectacular, unless the people had special interests in the objects and phenomena of the sky which might cause them to choose less dramatic sky events. The astronomical items selected will, then, reflect the ethos of the groups, telling us something about the types and intensity of interests the people keeping the counts had in the sky which constantly passed in review over their heads.

The counts mentioned many sun dances and these will not be included in our analysis except to note that the sun was obviously the object of the sky of primary importance to the Indian groups under consideration in this paper. It would be interesting to study historic sun dances of the various Plains groups to see what relationships, if any, exist to solstice dates, but this is outside the scope of this paper. Let us now consider the year-count entries of possible astronomical interest chronologically.

A buzzing (humming) noise heard throughout the land (1741). Howard (1976: 33) suggests that the event referred to in the John K. Bear (48) winter count might have been " . . . a diurnally occurring bolide (*i.e.* a large exploding meteor)". By this he apparently means that it might have been a daylight fireball (not one repeating each day as the term diurnal might imply) which produced the sonic phenomena common to spectacular fireballs. The acoustic phenomena accompanying fireballs are often complex: usually there are several sonic booms followed by clattering or rumbling which might go on for some tens of seconds. The booms are produced by large fragments and the other sounds by smaller fragments all moving beyond the speed of sound. The entire acoustic event may last the better part of a minute. Considering all of the complications of a mnemonic record of the type we are considering, it is conceivable that a meteoritic event might be remembered as a humming or buzzing sound, but certainly this is not a very satisfying description. Daylight fireballs are generally easily visible in addition to any acoustic phenomena which might be observed. Of course this depends on clear weather. With overcast sky a meteoritic event might have been heard and not seen and, through time, might have been remembered as a humming or buzzing sound in the region under the meteorite trajectory. A pictographic record would certainly help us be more certain about the nature of the event reported in this winter count, but, alas, the John K. Bear (48) count is one of those where the pictographs were dropped from the surviving copy of the count. Without additional information, further speculation about this winter count year record is pointless.

Eclipse of sun in winter (1781 or 1783). An annular solar eclipse occurred in Blackfoot country on 12 April 1782 (Oppolzer 1962, chart 143). Recalling that

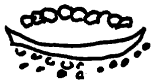

FIG. 4. The Bull Plume winter count pictograph, redrawn by the author, which probably depicts the Leonid meteor shower of 1799.

the Blackfoot people resided at about 50° north latitude, it would not be surprising to find an event taking place in April referred to as occurring in winter. It is noteworthy that this event was chosen as the one for remembering the year, since it was not a total eclipse. This combined with the fact that the Bull Plume (56) count reports a total of five possible astronomical events leads to the suggestion that the keepers of this count might have had special interest in what went on in the sky. This is particularly interesting since the other Blackfoot counts report so few astronomical events. Perhaps further study of the specific group of people represented by this winter count might reveal a degree of astronomical awareness unusual within the Blackfoot culture.

Winter when the stars fell (1788 or 1795?). Figure 4 shows the pictograph used in the Glenbow Institute copy of a winter count record of an apparent meteor shower occurring during the later part of the eighteenth century. This is another of the possible astronomical events reported in the Bull Plume (56) Peigan (Blackfoot) winter count. Study of both the archival copy of this count at the Glenbow Institute and the published version by Raczka (1979) reveals uncertainty about the dates assigned to the years. The only great meteor shower known to have occurred during the era in question is the Leonid shower of 1799. Although this shower was not well observed and recorded, it certainly must have been a spectacular event where weather permitted its observation. The best known account of it is that of the famous naturalist Humboldt who had arisen early on the morning of 11 November, noticed the meteoric activity and observed it for two hours prior to dawn. His account indicated hundreds of thousands of meteors visible during the two-hour period. It is not known how long the meteoric activity had been intense before he chanced to notice it. Since Humboldt observed the shower from Cumana in South America, it is certain that intense meteoric activity would have been visible, weather permitting, during the night hours in Blackfoot country. Much of western North America was still not frequented by the types of people who would report such phenomena to scientific centres. Perhaps weather patterns in America were such that the shower was not well observed in sections of the country where it would be so noted, but was where the Blackfoot Indians resided. From what is known about spectacular meteor showers in the late eighteenth century, the 1799 Leonid shower seems the most likely one to have inspired the Bull Plume (56) remembrance. Realization of this may help winter count scholars refine the sequence and year assignments for the Bull Plume count, which is probably a rare remembrance of the 1799 Leonid shower.

A star passed by, bellowing like a buffalo (1821/22). The Ironhawk (6) reference to the star sounding like a bison is but one of the many interesting descriptions of what was surely a very spectacular fireball observed in Teton country sometime during 1821 or 1822. The majority (88 per cent) of the Teton and Yanktonai counts which encompass the years 1821/22 clearly record the

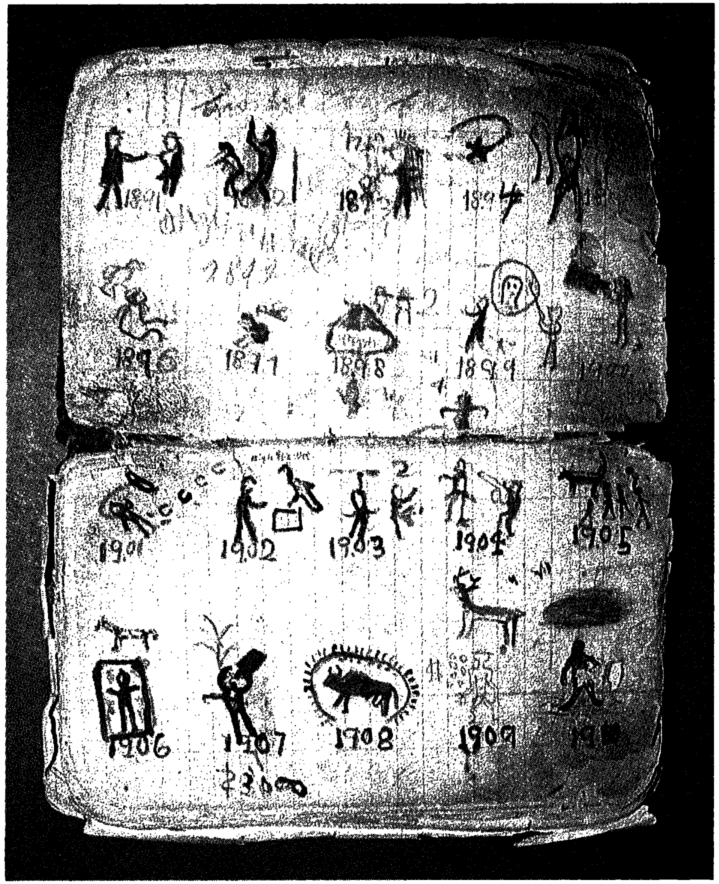

PLATE 6 (a). Two pages from the Sioux Indian Museum copy of the Battiste Good count, photographed by the author. Notice High Hawk's name written on the top page and compare the pictograph for 1894 with that for 1822 in Plate 5.

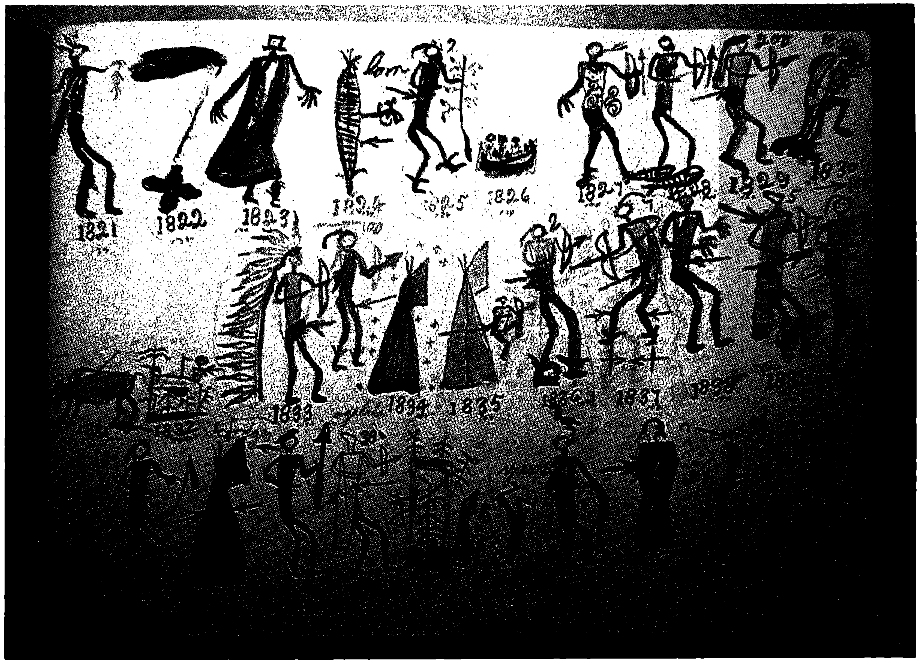

PLATE 6 (b). A page from the copy of the Battiste Good winter count located at the National Anthropological Archives, Smithsonian Institution, reported by Mallery to have been made for him by Battiste Good. Compare general artistic style and specific pictographs for 1822 and 1834 with those on the Sioux Indian Museum copy shown in Plate 5.

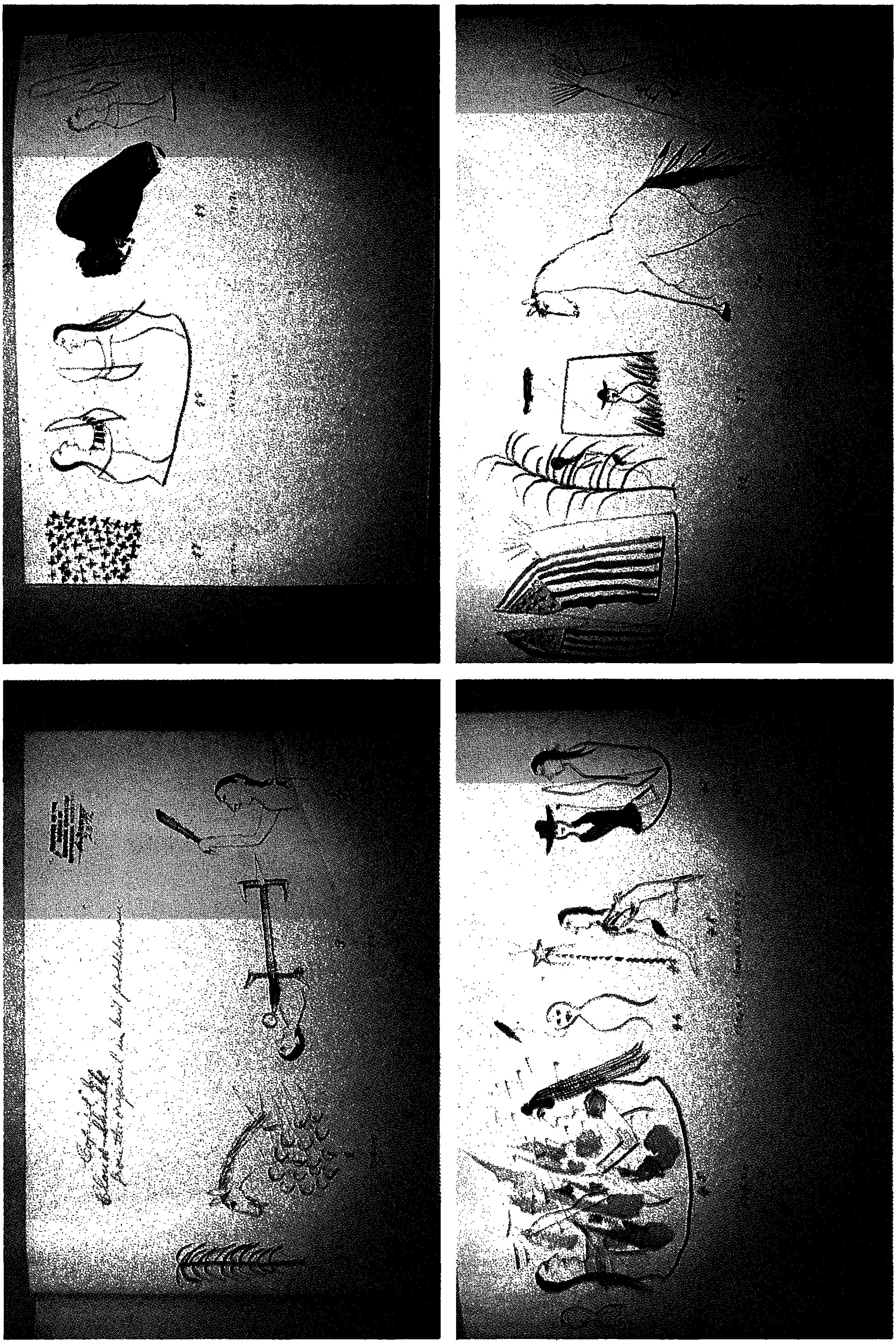
Copied by
Cloud Shield
from the original in his possession

PLATE 7. Four pages from the facsimile of the Cloud Shield winter count, made by Cloud Shield for Mallery, and located at the National Anthropological Archives, Smithsonian Institution. Photographs by the author.

event, but it is not mentioned in the other winter counts. This is not surprising since fireballs are typically observable over regions only a few hundred kilometres in diameter.

Since the winter counts reveal a complex nature for the 1821/22 event, a brief description of observable fireball phenomena follows. The observable characteristics of a particular event depend upon a number of variables: entry velocity, angle of entry, entry mass and composition of the meteorite body, shape of the meteorite, weather and time of day. It is not uncommon for a night-time fireball to light the sky like day for a few seconds and a daytime event can be clearly seen as a brilliant object traversing the bright clear blue sky. The light phenomenon typically lasts in excess of four seconds and up to ten or twenty seconds, occasionally longer. The fireball frequently emits bursts of light and sometimes breaks into parts, particularly near the end of visible flight. Sometimes it ends in a Roman Candle burst effect, breaking into a shower of "sparks". The colour of the light is usually described as blue-white, greenish-white or just white and often takes on a reddish glow just before extinction. A glowing ionization trail may persist following the brilliant light. More commonly, a trail formed by ablation material is left behind the fireball and this soon begins to be distorted by atmospheric currents. The end-point of this ablation trail is frequently enlarged and has been sometimes described by observers beneath it as "boiling" for a time after the glowing fireball disappears. Hissing "electric" sounds have been reported simultaneously with the fireball. Several minutes after the fireball, sonic booms arrive on the ground beneath the meteorite trajectory. The audible phenomena may be very complex: each fragment of the fireball, large or small, moving beyond the speed of sound may produce a sonic boom. Following a few distinct sonic booms, the shocks from smaller fragments along with echoes may produce a clattering, rumbling sound which may persist for a minute or so. The descriptions of the sounds depend upon the times and cultural circumstances of observers: they may be described as repetitive cannon fire, machine-gun fire, the sound of a tug-boat, the clattering of a wagon on cobble-stone or thunder, depending upon the era in which the fireball occurs and upon sounds common in the repertory of audible experience of the observers. If meteorite fragments reach the ground, observers in the fall area may hear them, soon after the other audible phenomena, whizzing through the air and striking the ground. These meteorites may even be seen as dark objects passing through the air and when they strike the ground they may produce clouds of dust or throw clumps or sprays of dirt. Pieces, large or small, even microscopic, may strike trees, rocks, buildings, animals or even people. Larger fragments may produce deep holes, or even shallow craters in the ground: very rarely they have been known to level stands of trees or produce true explosion craters, but such phenomena are clearly beyond the nature of events discussed in this paper.

Reference to Table 1 reveals a great deal of interesting information about how the people involved in the 1821/22 winter count records remembered the event. Iron Shell (42) called the year of the fireball "Whistling Star" and Hassrick (1964: 307) added, "according to Iron Shell, the shooting star whistled as it appeared". The Flame (12) winter count is similar, "Large ball of fire with hissing noise". If we take these two records literally, they appear to describe the

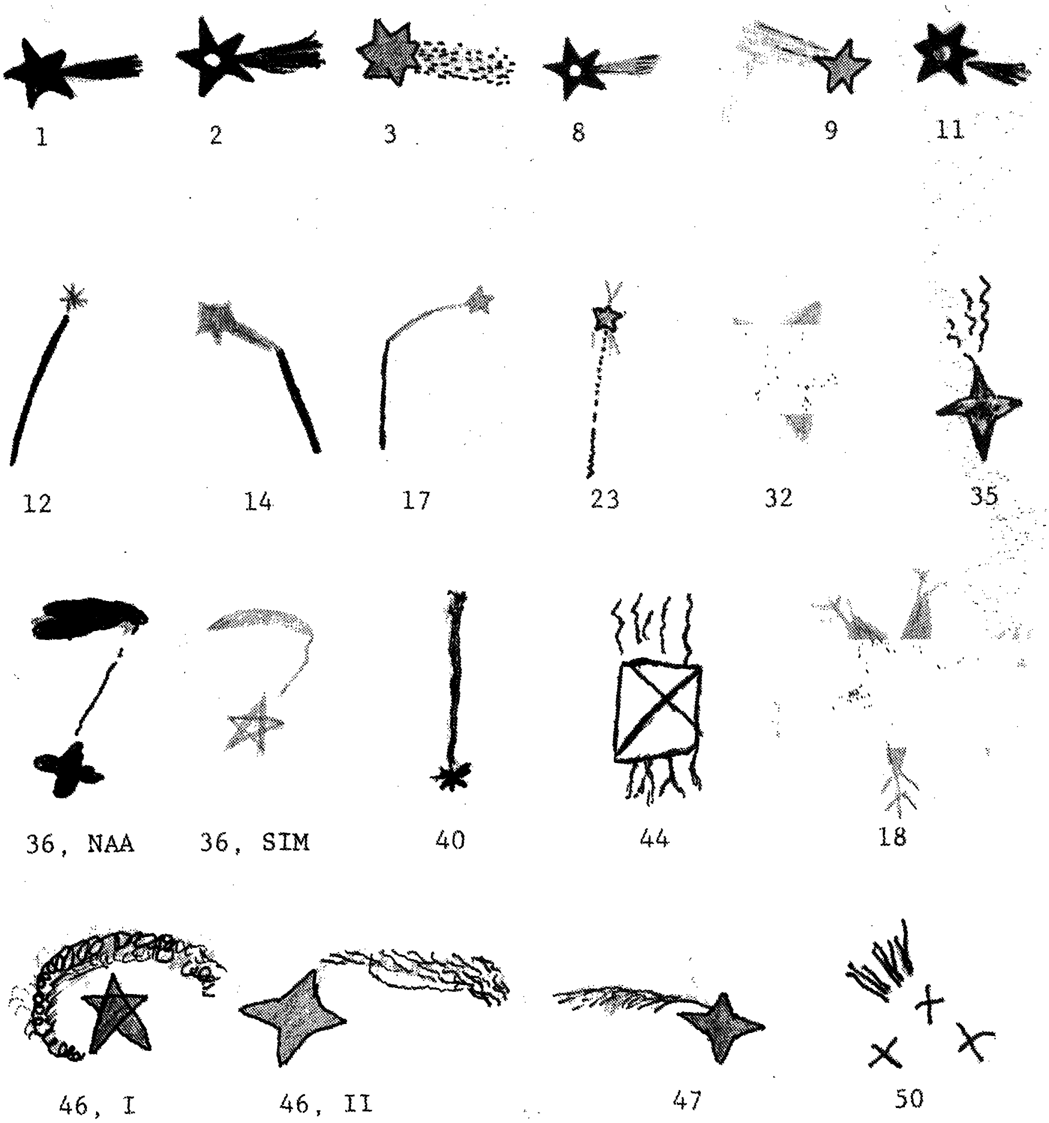

FIG. 5. Pictographs for 1821/22, redrawn by the author, symbolizing the spectacular fireball observed by the Sioux. Numbers indicate winter counts as listed in Table 1. Pictographs are shown for both copies of the Battiste Good (36) count: NAA = National Anthropological Archives; SIM = Sioux Indian Museum.

sounds sometimes reported to occur simultaneously with a fireball. To assume that these counts single out such a possible feature of the event, in view of the much more impressive phenomena which must have accompanied it, is placing too much confidence in these two records and the exact words as they have come down to us through memory, transcription and translation. The words are more likely personal variations of the complex audible phenomena following the fireball, or perhaps indications that some of the Sioux actually observed meteorite fragments swishing through the air and striking the ground.

Most of the accounts clearly associate loud sounds with the fireball. This alone is interesting since it takes several minutes for the sonic booms to reach the ground after the fireball itself has disappeared. In modern days it is not

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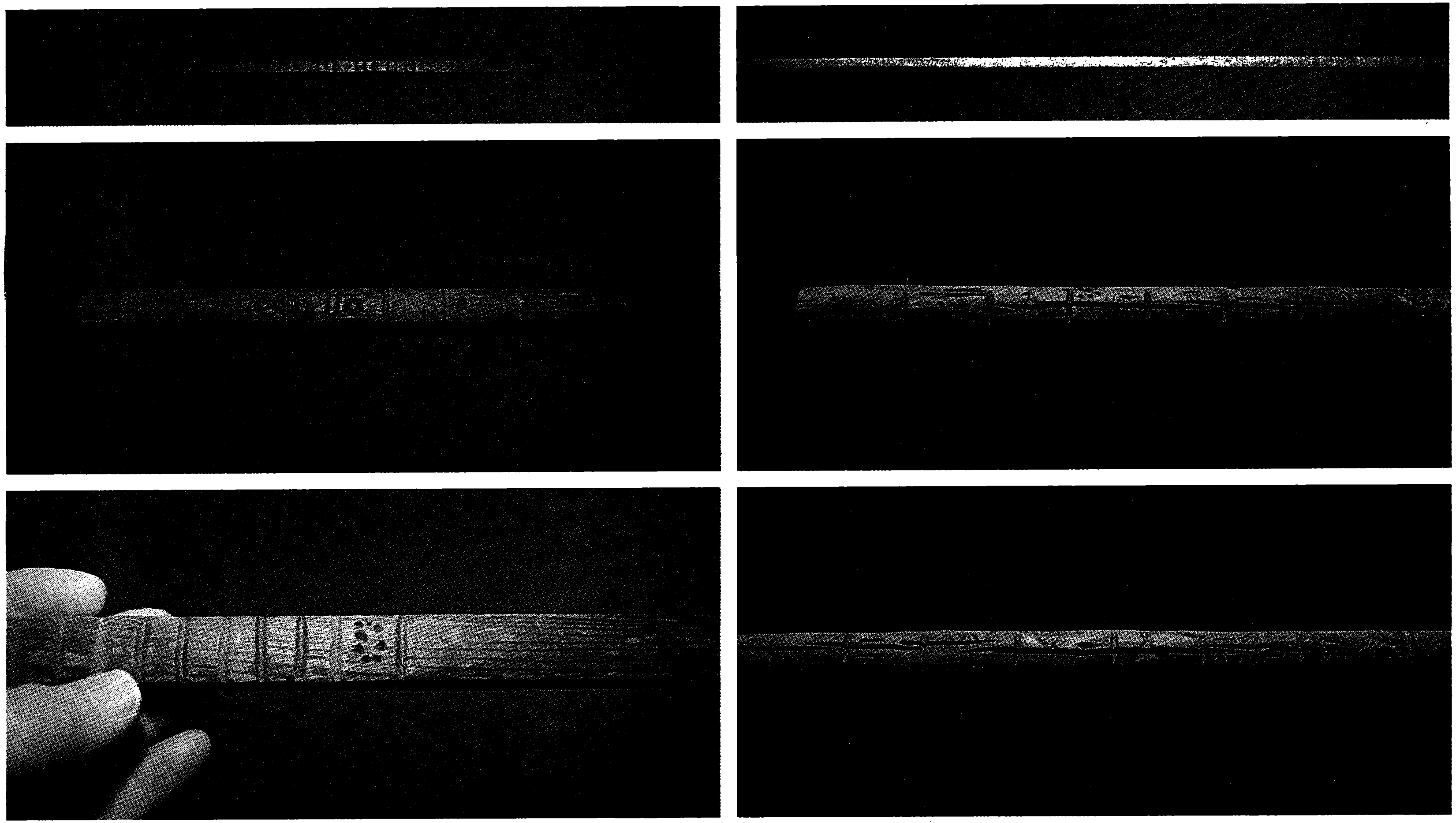

Plate 8. Two Pima calendar sticks from the collection at the National Museum of Natural History, Smithsonian Institution. On the left is specimen number 218,134: entire stick at top; close-up of a portion of the stick at centre; and close-up of the beginning of the record at the bottom where the pattern of holes represents the first year of the record, the meteor shower of 1833. On the right is specimen number 218,135: entire stick at top and close-ups of portions at centre and bottom. Photographs by the author.

uncommon for newspapers and other reports of fireballs *not* to relate the sonic booms to the fireball at all, and sometimes reports indicate two separate events: the brilliant fireball and explosions of a supposedly unrelated nature. Most of the winter counts clearly ascribe the sounds to the star: "Star-passed-by-with-loud-noise" (40); "A Big star went along making a loud noise" (45); "A large roaring star fell" (23); " . . . a star was seen and heard in the air" (1); "When the moving star sounded" (24); "A big star gave a loud voice signal from the air" (9); "Falling star that made a noise" (26); "Star a bellowing passed by" (4); "A-big-noisy-star-passed Winter" (44); "One-star-made-a-great-noise winter" (34); "A moving star roared" (25); "A star burst loudly and went on" (35); "Echo of a sounding star" (28). This last year name is especially appropriate, since the delayed relationship between the sound and light could nicely be described as an echo and since the sonic booms are frequently multiple, reminding us of the echo phenomenon.

Two of the winter count year-names and pictographs indicate that the fireball fragmented, at least to some extent, along its course. According to Cloud Shield (23), it "shot out sparks of fire along its course. Its track and the sparks are shown in the figure". Swift Bear (44) indicated, "The streaks show that it let off particles of light in its passage". These two pictographs are shown, along with others for this event, in Figure 5. Some of the other pictographs seem to indicate the trail of ablation debris left along the path of the fireball and the Battiste Good (36) glyph appears to show the cloud at the end-point. This record states, "In the figure the meteor, its pathway, and the cloud from which it came are shown". Taken literally, this is a suggestion that meteorites might have been observed to fall to the ground, coming from the direction of the cloud.

Five of the counts—Bush (13), Mato Sapa (15), Cloud Shield (23), The Swan (17) and John Colhoff (27)—refer to directions associated with the fireball. The John Colhoff record seems confused. The literal year-name merely refers to the visible and audible phenomena, but the interpreter added, "A roaring shooting star rose from the east and west seen by the Oglalas". This could not describe any one observation. Perhaps the interpreter was mistaken in the words used. It is also possible that there is a transcription error. The word 'west' might have been intended to be 'was'. It is possible, however, to interpret the record as meaning that different observers saw the fireball from different geographical locations so that one group saw it toward the east and the other saw it toward the west. John Colhoff is an Oglala count and the Oglala band is known to have had its members typically dispersed into many different places. Indeed, the name Oglala means "Scatters one's own", for this reason. Even with this interpretation, we cannot take the words completely literally: one group would not see the object rise from the east while the other saw it rise from the west. The Cloud Shield count, another Oglala count, merely reports that the fireball came from the east. Bush, Mato Sapa and The Swan are all Miniconjou counts and all of them report that the fireball passed from southeast to northwest. One would need to know the location of reference of these reports for them to have any significance about the fireball trajectory and much more information would be needed in order to estimate that trajectory. Such records, from memory, could not be relied upon, even if accurate, but it is interesting to note that the winter counts do report directional information.

Several of the winter counts—Cloud Shield (23), Wounded Bear (35), Battiste Good (36), Swift Bear (44)—indicate that the famous Oglala chief Red Cloud was born in the year of the brilliant roaring star. Stephen Feraca (private communication) has indicated that the proper translation of Red Cloud's name means "scarlet sky" with emphasis on the brilliance of the sky, therefore "bright, red sky". Hyde (1937: 34, 316–17) presents the argument that the name Red Cloud refers to the "lurid glare" of the fireball. He also states that other Indians had been named for the event: a pair of twin boys named Roaring Cloud and Fire Cloud and another Indian, about the same age as the Oglala chief, who was also named Red Cloud.

Hyde (1937: 34) also gives a date for the fireball. He cites a record from Fort Anthony, later renamed Fort Snelling, which reports a fireball occurring on 20 September 1822. The source of this information is Keating (1824: 304–5) where the following report from Josiah Snelling, builder and first commander of the fort, is found.

> Fort St. Anthony, July 8th, 1823.
>
> SIR—On the evening of Sept. 20th, 1822, while crossing the parade of this post, from the store to my own quarters, I was startled by a brilliant light in the atmosphere, and looking up, saw a meteor passing in a direction nearly from north-west to south-east, and as well as I could judge at an angle of about fifty degrees with the horizon; it appeared of uncommon magnitude, and passed so near me that I distinctly heard its sound, which resembled that of a signal rocket; in its descent my view of it was intercepted by the Commissary's store, but I heard it strike the ground, when it sounded like a spent shell, though much louder. I went immediately to the sentinel at the corner of the store, and asked him if he had seen any thing extraordinary; he replied that a large ball of fire had passed very near him and struck in the public garden which borders the river St. Peter; he appeared much agitated; after requesting him to mark the spot where it fell, I proceeded to the other sentinels, whose accounts, as far as their stations allowed them to judge, agreed with his. The next morning I went early to the spot where the meteoric stone was supposed to have fallen, but could not find it; the ground is alluvial and much broken into holes or hollows. I continued my search until the breakfast hour: but my ordinary avocations called off my attention, and I did not look for it again; which I have since regretted, as I think it might have been found by going to a greater deapth in search of it. The evening was uncommonly fine, and the concurring testimony of all the persons who saw it, with my own observation, I presume, will be sufficient evidence that it was no illusion.
>
> I have communicated this incident, as the question whether meteoric stones do or do not fall from the atmosphere has recently excited much interest, and it may be deemed in some measure of importance in support of the affirmative proposition.
>
> Respectfully,
> I am, sir, your obedient servant,
> J. SNELLING
> Col. U.S. Army.

I have communicated with the Minnesota Historical Society and obtained information about Fort St Anthony as it existed in 1822 (Heckle n.d.). The fort was built in a diamond shape with the commanding officer's quarters located roughly at the east corner. The commissary store was at the south corner, mostly outside the perimeter. There were two gardens bordering the Minnesota River, which was called the River St Peter's at that time: the Officer's Gardens were located south of the fort and the Public Fields were located on Pike's Island southeast of the fort. Snelling's report indicates that the fireball moved in the sky from the northwest, descending at a fairly steep angle toward the horizon in the southeast. His conclusion that it landed in the public gardens suggests that it went beyond the horizon, or at least low enough to disappear beyond trees or other landscape features. Since it disappeared from his own view behind the store, Snelling apparently determined that the sentinel at the store and others had a better view of its intersection with the ground in the southeast (or south if the garden referred to was the Officer's Gardens). He specifically referred to the public garden and his search in the gardens establishes that he was convinced of the direction. It is not at all unusual for people to conclude that meteorites reach the ground near-by when the fireball actually goes beyond the horizon. This seems to be what happened in the case under discussion.

Snelling's report also indicates, however, that one or more sonic booms were heard. This is most typical in the end-point region of a fireball. But if the fort was near the end-point, the fireball would have disappeared high in the sky and the sounds probably would have been *very* dramatic and would surely have been emphasized even more in the report. Occasionally sonic booms can be heard up to 100 km away from the end-point and very rarely several hundred kilometres away. In every case it requires several minutes for the sound to arrive after the fireball. In recalling the event, people often misjudge the time lag between visible fireball and sonic booms. The evidence suggests that Snelling's report was no exception; he described the event as though the sounds were simultaneous with the fireball. We are left uncertain about whether or not the fireball passed beyond the horizon, but it seems clear that it reached a point in the sky to the southeast of Fort Snelling, a direction nearly opposite from that of Teton country.

Fort Snelling is located at the intersection of the Minnesota and Mississippi Rivers (Figure 3), near St Paul, Minnesota, more than 500 km east of where the Teton and Yanktonai Sioux resided. Considering all the evidence, it seems certain that the fireball observed at Fort Snelling was not the same one recorded in the winter counts. At least two other books, National Geographic Society (1974: 312) and Ruth Beebe Hill (1979: 22), have picked up on Hyde's assumption and stated that the winter count fireball occurred on 20 September 1822.

Another description of a spectacular fireball of unknown date has been recorded from about 800 km west of the Teton Sioux country. Clark (1966: 109–10) has preserved this wonderful account as follows.

> The world was very young when this story took place. It was before our grandfathers' grandfathers' days, but there were people who saw these things. They saw the burning star race through the air and jump into the lake now called Flathead Lake.

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> One darkness, when the people were in their tipis, they heard a star shrieking in terrible pain. Going outside to see why it was making such crying, they saw that it was burning up. The light of the flames brightened all the sky and the land as if it were day instead of night.
>
> The people saw Star running swiftly down to the lake and jump into the deep water near Wild Horse Island. Immediately a thick cloud rose from the water and hung over the lake.
>
> Our people were very much frightened and would not go near the shore. "The Water Mystery," they said, "has reached out with its strong power, has pulled the Star from Skyland, and has taken it into the lake. If we go near it, it will pull us in also."
>
> But the Mystery People of the Lake, the Canoe People, said, "No, it is not the Water Mystery which pulled Star, for water mysteries have no influence over sky and land mysteries. Foolish Salish, do you not know this? We, too, saw Star burning in the sky, and we heard its cry of pain as it jumped into the lake to put out its flames. Not being made of fear, we paddled our canoes close. The water was warm, and many, many cooked fish floated on the waves."
>
> Tribes that lived many sleeps away also saw Burning Star and its light. Only the Mystery People of the Lake were not afraid. So our fathers sometimes called them "the Fool People." Perhaps they meant "the foolhardy people."
>
> These are true words.

This, too, must have been a very impressive event, complete with visible and acoustic phenomenae and ablation trail persisting after the fireball disappeared. It is tempting to speculate that this might be a remembrance of the 1821/22 event, but once again it is too far away from Teton country. It is included here to indicate how dramatic fireball events can be, how they tend to be remembered by those who witness them and how they occur more often than is realized by most people. Even though the average person has not witnessed such an event, we must remember that impressive fireballs occur rather frequently throughout the world. The Fort Snelling record and the Flathead Lake one are almost certainly independent events not related to the Sioux winter count fireball and the exact date of the latter is yet to be determined. The author has looked for other records of the event without success.

We can be sure that the Sioux people had witnessed many other fireballs throughout their history. Why was this one singled out and remembered in such a descriptive way? Let me speculate a little on the basis of personal experience with fireball events and what is preserved in the winter counts. First of all, the 1821/22 fireball must have occurred when the weather throughout the region was clear and it must have happened at a time of day, perhaps early evening, when many people were engaged in activities which favoured observation of the sky. The sky was probably dark, but no doubt many people had not yet retired to their houses. This must have been a *very* impressive event and the people keeping the winter count records were almost certainly in the end-point region where the phenomena, both visual and audible, were especially pronounced. The sky probably became very bright and the landscape was suddenly flooded with brightness which was sustained for several seconds. The light probably pulsated as the meteorite tumbled and fragmented. This may well have been an unusually prolonged fireball, perhaps lasting more than ten seconds, brightening as it came, fragmenting and changing colour, becoming somewhat redder toward the end and finally disappearing in a flash nearly overhead. If it was early evening, sunlight would have illuminated the ablation trail in the otherwise darkened sky, attracting continuing attention of the amazed people who began to talk about what they had seen. Their deliberations of the meaning of this blazing messenger from the heavens were interrupted by successive sonic booms, some literally shaking the ground. People might have felt the low frequencies vibrating their clothing and the things around them. The voice of the star confirmed the importance of what they had seen and they even felt its presence. The ablation trail in the sky continued to dissipate. Perhaps the reddened evening sunlight reaching the trail gave the cloud a ruddy glow which lead to the name of an Oglala infant boy who would become famous to Indians and others in times to come. If any of the bands were camped where meteorite fragments came to earth, they would have heard these buzzing and whistling through the air and hitting the ground. Tiny fragments might even have pelted the area around them and perhaps some of the people even recovered larger fragments which became sacred objects, but if this is so we have no evidence of it from the winter counts. It seems likely that the people may have often deliberated about the fiery star over the coming days and months. Perhaps the object was even one of the subjects discussed at inter-tribal meetings. Finally, when it came time for the tribal historians and others to select one event for the painted mnemonic record of that year, the choice was probably easy: although they would use different words, most of the historians would call this the year when the great star came to earth, both visually and audibly announcing its presence, and to help them remember they would draw little pictures of a star burning its way across the sky.

In summary, we can say that the 1821/22 fireball event was an example of a truly spectacular fireball observed by the Teton and Yanktonai Sioux who singled it out as the most significant event of the year and who left us a very interesting example of how such an impressive, yet relatively common, event can affect human cultures. The records which they left us describe all of the observational elements of a spectacular fireball, witnessed from the end-point region, and leave us wondering whether or not the Sioux actually observed meteorite fragments fall to the ground.

Storm of stars winter (1833). The famous Leonid meteor blizzard of the night of 12–13 November is included in almost all of the calendars. Indeed, it is the single most important event of known date for establishing the chronology of winter counts. The year-names themselves vividly describe the event: “Winter of the falling stars” (1); “Stars shower down” (2, 4); “Stars moved around” (21); “The stars all changed around the sky” (9); “Stars/they go in all directions” (22); “When the stars were shooting” (24); “Shooting stars like snow flakes in a storm” (27); “It rained stars” (23); “Storm of stars winter” (36); “Plenty-stars winter” (34); “Moving stars” (41); “Shifting stars” (42); “Stars shoot off” (8); “Stars flew around like bird” (45); “When lots of stars fell” (56). Figure 6 shows pictographs from the calendars.

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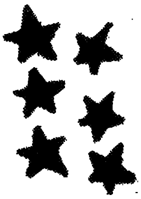

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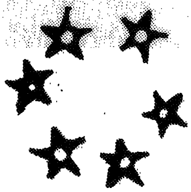

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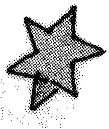

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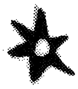

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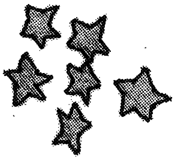

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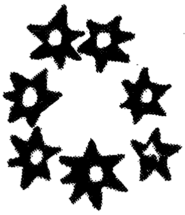

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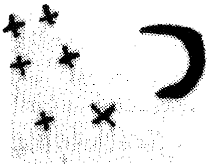

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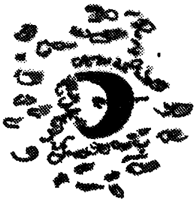

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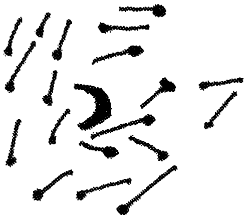

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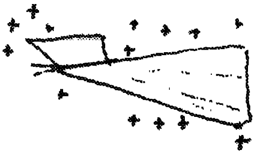

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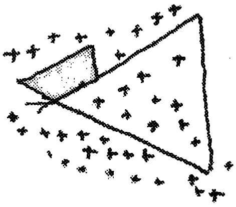

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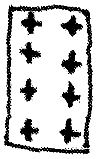

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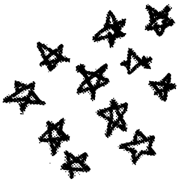

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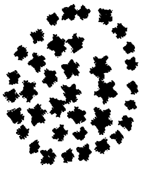

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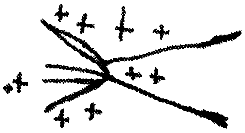

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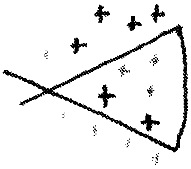

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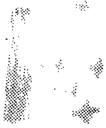

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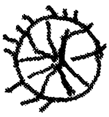

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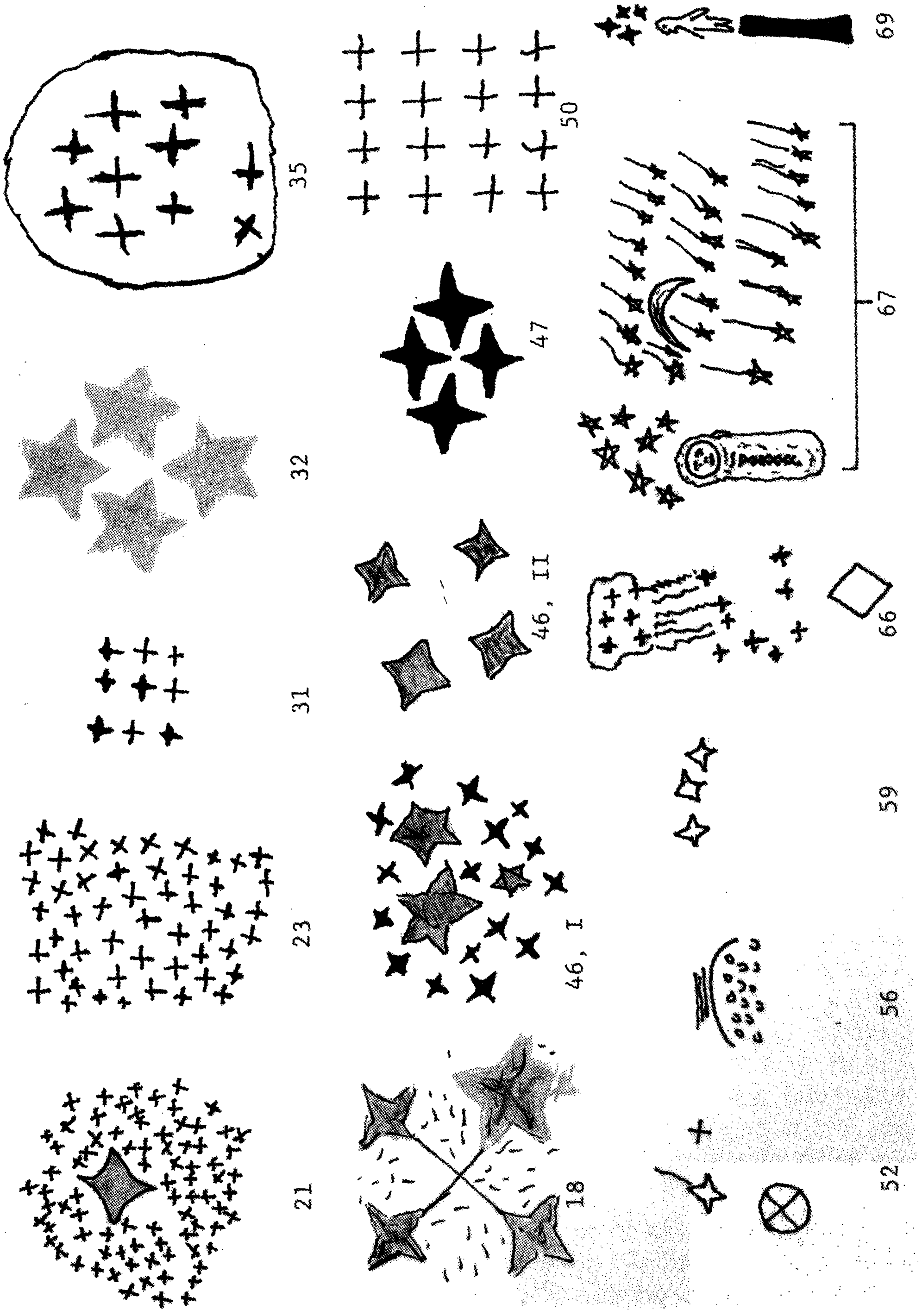

FIG. 6. Pictographs for the 1833 Leonid meteor shower, redrawn by the author. Numbers indicate winter counts as listed in Table 1.

The Moon was new just two days before the height of the shower. The crescents used in several of the pictographs were probably intended as night symbols. Skies were dark providing ideal conditions for observing the shower.

We have little information about what the Indians actually thought about the meteors. The High Dog (2), Bush (13), Mato Sapa (15) and Swan (17) winter counts indicate that some of the people felt fear and concern. The High Dog interpreter stated that they feared the Great Spirit had lost his control over the creation. Mooney (1898: 260–1) stated that the Kiowa

> . . . were wakened by a sudden light; running out from the tipis, they found the night as bright as day, with myriads of meteors darting about in the sky. The parents aroused the children, saying, "Get up, get up, there is something awful going on!" They had never before known such an occurrence, and regarded it as something ominous or dangerous, and sat watching it with dread and apprehension until daylight.

Buffalobird-woman's entry in the Mandan Butterfly (51) winter count (American Museum of Natural History n.d.) includes the following for the year 1833/34:

> I have heard of that story: all the stars in the sky fell to the ground. The Crow people in the mountains saw them; and our people saw them falling also.
>
> It happened at night. But no one knows just what the stars were, or if they really struck the ground. I do not know whether the Indians were frightened by the falling stars or not.

Unpublished material from the Glenbow Institute, filed with the Blackfoot winter counts, includes the following told by Joe Little Chief:

> In the year of 1834 the stars fell down this is how it happen that year a Medicine man the above spirits such as the moon the stars gives him his power he was very powerful every body knew him and about his power every-body went to him when they got sick he cured them he helped the poor and the sick his name was Bull Got Lift [Left] in a battle with the Crees also some half breeds they were out hunting when the Crees sighted them and give chase they were three Blackfeets so they had fast horses so as they were far away from the Crees Bull Got Lift's horse step in a hole and hurt his leg he told his friends never mind me save yourself and they left him the Crees got to Bull Got Lift they all got off their horses the Crees said we better not kill him he is a Medicine Man we will sure have bad luck but the half breeds said kill him so one half breed shot Bull Got Lift and killed him as soon as he was killed it turn dark the moon was not seen in the sky all the stars look like if they were falling down or they were jumping to each other it stayed that way for nearly two days the Crees half breeds got very bad luck.

A two-page document from H. M. Hiatt (n.d.), located at the National Anthropological Archives in Washington, shows nine pictographs and associated year-names for the 1833 shower. Hiatt noted that he had been impressed by a display of winter counts at the Worlds Exposition at Omaha and he proceeded to obtain copies of them. Two of the counts in his list are otherwise unknown. Whether or not they represent real winter counts remains to be verified. The two entries for 1833 are: Iron Dog, "Rain of stars winter"; and Sitting Bull, "The Great Spirit's storm of stars winter". Since nothing else is known about these supposed winter counts, they are not listed in Table 1 and the pictographs are not included in Figure 6.

We note in passing that the Old Bull (10) count misplaced the shower, listing it for 1841, but this count is known to be off by seven or eight years. Several other counts show it for 1835 and the Wind-Roan Bear (49) count lists the shower twice: for 1832 and 1833. These are undoubtedly due to problems in exact chronological interpretations which need not occupy our attention here.

The pictographs are an interesting combination of symbols ranging from groups of four, five and six pointed stars to streaks representing the meteors. None clearly reveals the idea of the radiant of the shower. The Plains calendar records, taken as a whole, indicate that the Natives of North America were just as much impressed by the Leonid shower as were most people who observed it throughout the world.

Eclipse of Sun in summer (1864 or 1863?). This is another astronomical entry from the Peigan Bull Plume (56) calendar. Again we must be reminded of the uncertainty of the dates in this calendar. The copy at the Glenbow Museum includes the note, "The dates are only approximate and the sequence of events may be inaccurate as this was done orally and the original picture writing was either done from memory by his father or grandfather and so it is not known if it was remembered in exactly the correct order—or whether one or more events may have occurred the same year." There was a partial eclipse of the Sun on 16 May 1863. The Blackfoot people would have been near the southern limit of the eclipse. There was another solar eclipse on 5 May 1864, total across part of the Pacific Ocean, partial for the Blackfoot, with the middle of the eclipse not long before sunset in the Blackfoot region. Still another solar eclipse, this time an annular one with the central line not far from Blackfoot country, occurred on 19 October 1865. In the latter case, the partially eclipsed Sun would have been low in the sky after sunrise for the Blackfoot people. It is possible that this record deals with one of these partial eclipses. If so, it seems likely that it would be one of the eclipses which would have been seen low in the sky where it is more likely that the eclipse would have been noticed because of the favourable viewing angle and the greater possibility of dimming of the solar image by haze and thin clouds. Noting the general uncertainty of the dates in the Bull Plume calendar, it seems more likely that the eclipse intended for this record was the solar eclipse of 7 August 1869 which was total in Blackfoot country as well as in Teton country and which we will discuss next.

The Sun Died (1869/70). In addition to the probability that the Bull Plume (56) count pertains to the total solar eclipse of 7 August 1869, we find nine other probable records of it (one additional record, Houghton Running Rabbit (53), a North Blackfoot count, names the year, "Small pox years! Three Sun died"; this is a record of the death of a chief). Five of the records are Miniconjou: Lone Dog (14), The Swan (17), Bush (13), Mato Sapa (15) and Roan Bear (16). The latter of these was interpreted by Howard (1955: 24) as "Morning-sun a died", and he said it referred to the death of a man named Morning Sun. In view of the several other winter count records of the eclipse, it seems more likely that this

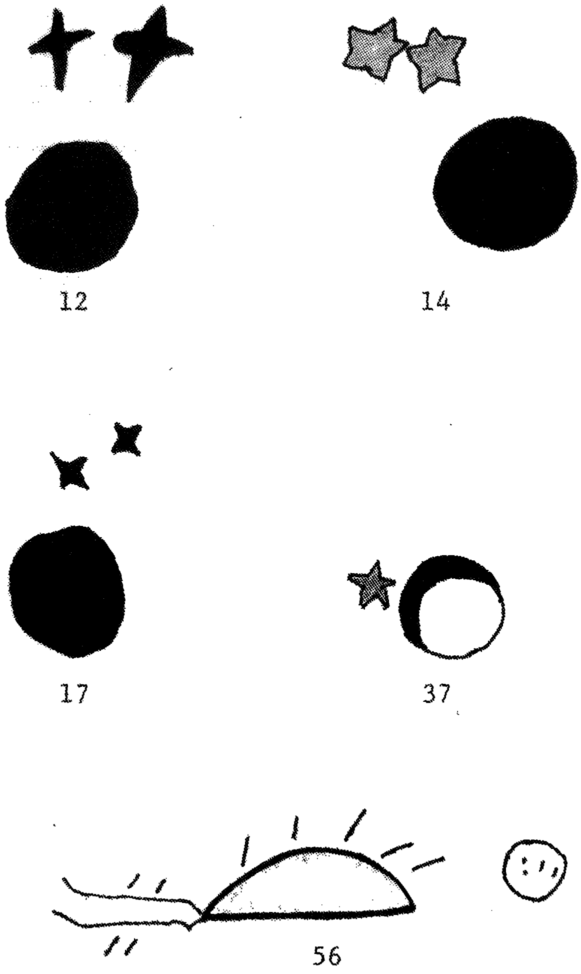

FIG. 7. Pictographs for the total solar eclipse of 7 August 1869, redrawn by the author. Numbers indicate calendars as listed in Table 1.

one, too, refers to the eclipse. Two of the counts recording the eclipse are Sicangu (Brule'): Iron Shell (42) and Big Missouri (37). One is Hunkpapa (unidentified) (4): "Daylight Sun a died". The other is Itazipco (Sansarc) and Oohenupa (Two Kettle), The Flame (12) winter count, which was interpreted, "Eclipse of the moon". All of these, including the last mentioned which speaks of the Moon instead of the Sun, were probably intended to record the total solar eclipse. There was no spectacular lunar eclipse during the year in question.

The path of totality for this and the other total solar eclipses discussed in this paper are shown in Figure 3. Both the Blackfoot and Sioux, from whom the winter counts under discussion came, resided in the path of totality of the 1869 eclipse.

The pictographs for the counts having them, including the one from the Bull Plume count, are shown in Figure 7. Some of these show a darkened solar disk with two stars near it. Is it possible that this is an accurate rendering of the appearance at the time of totality? At that time the Sun was in Cancer with Castor and Pollux about 25° to the right and Regulus about 15° to the left.

Mercury was between the Sun and the Gemini Twins only about 5° to the right of the Sun. Brilliant Venus was some 10° to the left of Regulus, about 25° left of the Sun. Figure 8 is a simulation of the eclipse: a photograph taken in the Albert Einstein Spacearium at the National Air and Space Museum. Certainly the pictographs are not accurate renderings of the positions of bright stars and/or planets at the time of the eclipse. Although it is possible that the two star images were intended to represent Mercury and Venus near the Sun, it is more likely that they were simply intended to indicate that stars were seen in daytime during totality.

It is apparent that the Indians were made aware of this eclipse prior to its occurrence. In this regard, it is interesting to compare Mallery's three publications. In the first (1877: 22) he noted:

> . . . it is learned that Prof. Cleveland Abbe, who was famed as an astronomer before he became so as a meteorologist, was at Sioux Falls City with a corps of assistants to observe this very eclipse, and explained the subject to a large number of Indians there at that time, so that their attention was not only directed specially to that eclipse, but also to the white men as interested in it, and to its real appearance as apart from their old superstition.

In the second (1886: 125–6) Mallery added to the above:

> In addition to this fact, Dr. Washington Matthews, assistant surgeon United States Army, communicates the statement that the Indians had

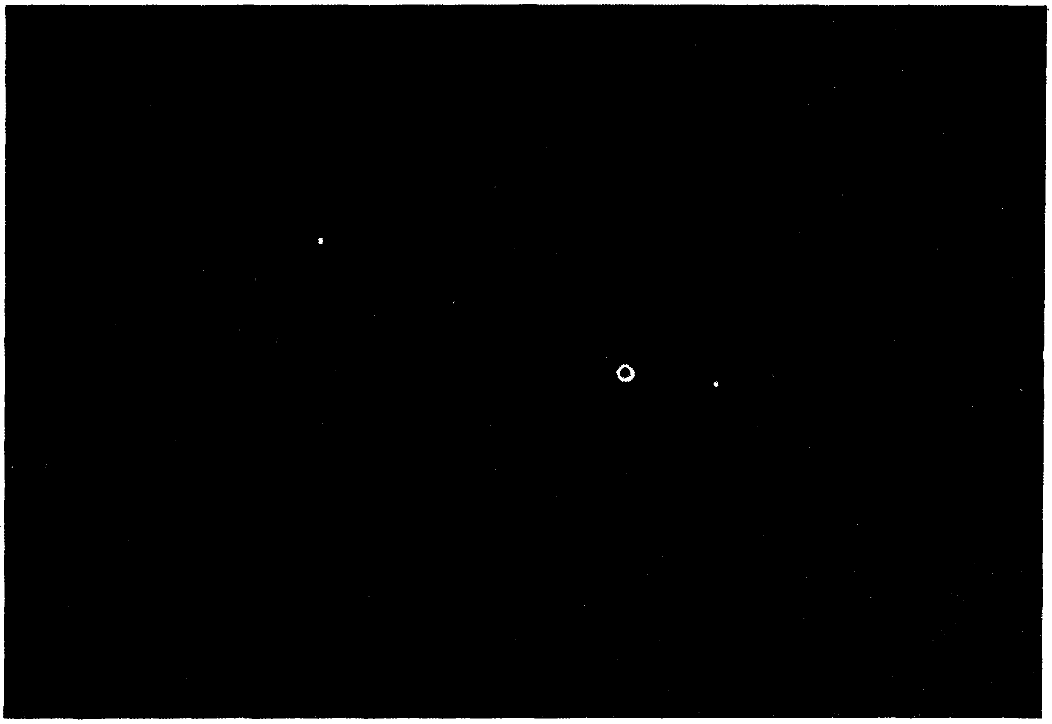

FIG. 8. Planetarium simulation of the total solar eclipse of 7 August 1869, photographed by the author in the Albert Einstein Spacearium, National Air and Space Museum. Mercury is to the right of the eclipsed Sun and Venus is to the Sun's upper left with Regulus between the Sun and Venus.

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> numberless other opportunities all over their country of receiving the same information. He was at Fort Rice during the eclipse and remembers that long before the eclipse occurred the officers, men, and citizens around the post told the Indians of the coming event and discussed it with them so much that they were on the tip-toe of expectancy when the day came. Two-Bears and his band were then encamped at Fort Rice, and he and several of his leading men watched the eclipse along with the whites and through their smoked glass, and then and there the phenomenon was throughly explained to them over and over again. There is no doubt that similar explanations were made at all the numerous posts and agencies along the river that day. The path of the eclipse coincided nearly with the course of the Missouri for over a thousand miles. The duration of totality at Fort Rice was nearly two minutes (1m46s).

In his last publication (1893: 286) Mallery omitted the reference to Prof. Cleveland Abbe, but included the comments about Washington Matthews, as above.

A rather humorous account of the eclipse among the Indians was cited by Poole (1881: 76–77) as having occurred at the Whetstone Agency.

> Some days before the great eclipse of August, 1869, Dr. C______, physician for the Indians at the agency, concluded to try his skill as a magician, and impress the Indians with his magic art, inseparably connected in their minds with the healing art.
>
> The doctor announced to some of the principal chiefs and warriors the coming event, telling them the precise time (taken from an almanac) when the sun would be obscured and darkness follow, until he saw fit to have it pass away. When the day and the hour arrived, the doctor had his audience in readiness, duly armed with smoked glass. Being within the line of totality, and having a cloudless sky and the clear, delightful atmosphere of the plains, the phenomenon was observed under the most favorable circumstances. There was no mistake as to time; the moon gradually crossed the disc of the sun, a black, spherical mass, surely putting out its light.
>
> The Indians were impassive lookers on, until, as the eclipse reached its culmination, leaving only a narrow, bright rim around the outer edge of the sun, the deepening steel-gray shadows attracted their attention, as well as that of beasts and birds. Then, concluding that the exhibition had gone far enough, and that they must drive away the evil spirits, they commenced discharging their rifles in the air. The light of the sun gradually returning, they were thoroughly convinced that it was the result of their efforts, and that the Indians' medicine was better than the white man's.
>
> The doctor could predict the eclipse, but they could drive it away and prevent any evil consequences arising from it. So the doctor failed in fully establishing himself as a big medicine man.

This was the only total solar eclipse which passed clearly through Teton and Yanktonai Sioux country during the period covered by the winter counts. The Moon's shadow passed close to the west of Sioux country on 30 November 1834, to the south on 16 January 1806 and just through the north of Sioux country on 1 January 1889. We will consider the last mentioned eclipse in a later

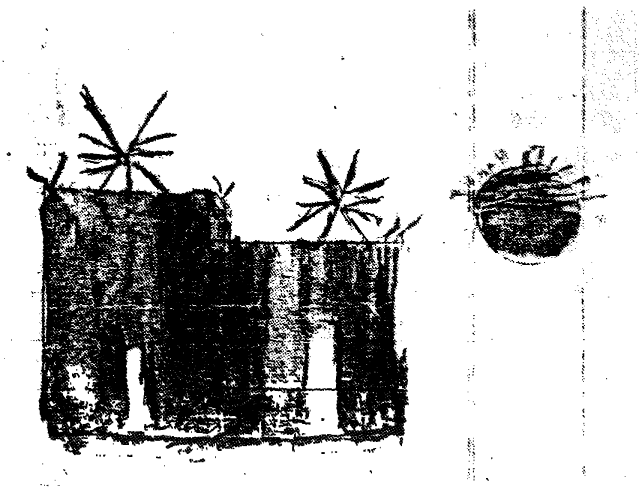

FIG. 9. Pictograph from the Ah-nan-ti Kiowa calendar depicting a Sun dance lodge with the Sun shown to the right to indicate the total solar eclipse of 29 July 1878.

section. This, alone, is reason enough that we find the eclipse of 1869 recorded on some of the winter counts. To what extent the recording of the event in the counts was influenced by the presence of White people is impossible to know. That influence might have decreased the numbers of counts recording the eclipse as easily as it might have stimulated the Indians to use it as the mnemonic event for that year.

Western migration of part of tribe under Plenty Stars (1874). This Kiowa record, from the George Poolaw (64) calendar, is another example of an entry which sounds astronomical, but is not. According to Stephen Feraca (private communication), "Plenty Stars" was a Kiowa leader. It would be interesting to know the origin of his name. Was he, perhaps, born in the year of the great meteor shower? We list this record in attempt for completeness in sorting out the Plains calendar items of potential astronomical interest.

Repeated Sun dance and the Sun was died (summer, 1878). Two of the Kiowa calendars report this important total solar eclipse. Ah-nan-ti (59) reported it as stated above, along with the pictograph shown in Figure 9, in a ledger book. The George Hunt (63) calendar refers to the year as "Double sun dance. Eclipse of the sun during the dance". The eclipse occurred on 29 July 1878 with the lunar shadow proceeding along the western edge of the Rocky Mountains, across the central highland of Wyoming Territory, into Oklahoma Indian Territory and across Texas into the Gulf of Mexico (see Figure 3). This put the path well to the west of Sioux country, so it is not surprising to not find it in the Teton winter counts. The Kiowa were living directly in its path. This and the 1918 eclipse to be discussed later were the only total solar eclipses which went clearly across Kiowa country during the period represented in the Kiowa calendars. Additional information about this important eclipse can be found in a variety of places including a very interesting popular article by Eddy (1973).

The Sun (or Moon) turned black and died (1888/89). During this time period we find winter count records which seem to indicate eclipses of either the Sun or the Moon. We also encounter the problem of confusion between the death of

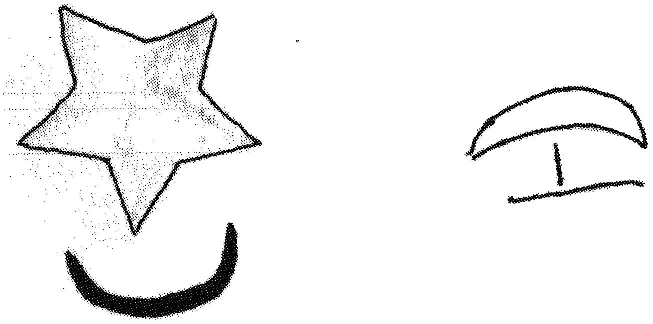

FIG. 10. The Short Man (left) and Bull Plume (right) pictographs which probably indicate total lunar eclipse. Redrawn by the author.

someone with an astronomical name and an astronomical event. High Dog (2) and Swift Dog (11), two Hunkpapa counts which are very similar to each other, both have pictographs of a person with a crescent attached to the individual by a line. This is the typical way name glyphs are shown in Sioux winter counts. The published interpretation of the High Dog count for 1888/89 is that the year-name literally means "Moon (or sun) black died", and that this indicated there was an eclipse of the Sun, that "The sun turned black and died". The text with the Swift Dog count located at the State Historical Society of North Dakota reads: "lit. Moon-black died. Black moon, Sitting Bull's uncle, died." Concerning these Howard indicated that the reference to an eclipse is probably wrong and that both counts record the death of the man called Black Moon and that this is recorded in the White Bull count as well. Feraca (private communication) has informed me that Black Moon was a chief. These two counts record the death of an important person, rather than an eclipse.

The situation is made more interesting, however, by the following facts: there was a total solar eclipse which went through the northern part of Sioux country on 1 January 1889 (see Figure 3); there were two total lunar eclipses visible throughout North America, one on 28 January 1888 and the other on 22 July 1888; there was a partial lunar eclipse visible on 16 January 1889; and two additional winter counts seem to record eclipses of the Moon and/or Sun.

The text for the Short Man (32) count, an Oglala count, at the American Museum of Natural History includes the interpretation, "Night sun a dead. The moon eclipsed". However, DeMallie has published this as "Eclipse of the sun". The pictograph on this count is a large five-pointed star above a crescent (Figure 10). The evidence favours the interpretation of a lunar eclipse for the following reasons: DeMallie's publication came from the material at the American Museum of Natural History and that material indicates a lunar eclipse; the pictograph shows what appears to be symbols for the Moon and stars; there were two total lunar eclipses and one partial lunar eclipse to choose from; the path of totality of the January 1889 solar eclipse just grazed the region of occupation of the Sioux and the Oglala, although tending to be somewhat scattered, were generally below the path of totality.

The other winter count recording an eclipse at this time is the Peigan Bull Plume (56) count, the one we have already noted as having some confusion on the year-dates. In this case the reported years agree closely: the Glenbow

Museum record lists this as 1889, "Eclipse of moon". Raczka published the year as 1888, "When the moon died (Eclipse)". The pictograph, a crescent, is shown in Figure 10. Which of the lunar eclipses was intended for this record is anyone's guess. It does seem rather appropriate for this to be called the year when the Moon died, since it was totally resurrected twice and mortally wounded once during the time in question.

The solar eclipse in 1889 is a very interesting one. Its interest to science has been well documented in various journals. In addition, this was the eclipse which occurred when the Paiute Messiah, Wovoka, claimed to have a vision which started the Ghost Dance Religion among many Indian groups (Mooney 1896: 771–4; Robinson 1956: 459; Lesser 1978: 53). The path of totality is shown in Figure 3. The best evidence, however, is that the eclipse was *not* recorded in the winter counts.

Eclipse of the moon (1891). Mooney (1898: 367–379) described a monthly calendar kept by the Kiowa from August 1889 to July 1892, known as the Anko Monthly Calendar (61). The symbol for each month consists of a crescent combined with a symbol to name the month. Added to this were additional symbolic variations to indicate events to be remembered. One of the events is astronomical, an eclipse of the Moon, indicated by the crescent being filled in to some extent as shown in Figure 11. The feather attached to the crescent indicates the name of the month, Aganti, which Mooney (1898: 368) explains as meaning, "wait until I come". Mooney further explains that this comes from Kiowa folklore and that this moon says to its predecessor, "You went, but did nothing . . . wait, and I'll go, and I'll show what I can do in the way of storms and cold weather". Mooney indicated that the month includes parts of October and November, but that some authorities speak of this month as "midwinter moon, i.e., midway between two consecutive sun dances, which would seem to bring it nearer to December". Mooney described and interpreted each symbol in the calendar, proceeding very consistently through the latter part of 1889 up to November 1891. At this point he wrote, "the crescent itself is filled in with black between the horns to note the fact of the total lunar eclipse of November 4, 1892, as recorded by the Nautical Almanac". The next pictograph completed the year 1891 and the following ones were for 1892. Thus, Mooney's conclusion that the filled-in crescent indicated an eclipse near the end of 1892 is completely out of sequence. This is particularly apparent when we note that the monthly calendar only goes up to July 1892. What is even more surprising about this error is that Mooney referred to the eclipse of 4 November 1892 as a "tally date" for the Anko calendar. Apparently Mooney obtained the correct basic information from his Indian informants, but did not check his almanacs carefully enough. He failed to learn that there was a total eclipse of the Moon

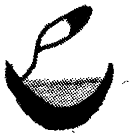

FIG. 11. Pictograph, redrawn by the author, from the Anko Monthly calendar indicating the total lunar eclipse of 15 November 1891.

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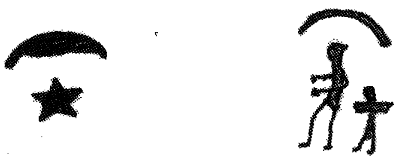

FIG. 12. Pictographs for 1822 (left) and 1894 (right) from the High Hawk winter count. Redrawn by the author. Compare with Plates 5 and 6.

visible generally throughout North and South America on 15 November 1891. The Moon entered the umbral shadow at 10.35 Greenwich Mean Time, totality began at 11.37, the middle of the eclipse was at 12.19, totality ended at 13.01, and the Moon left the shadow at 14.03. Thus, the eclipse would have been easily observable, weather permitting, in Kiowa country. The unusual Anko Monthly Calendar apparently records the total lunar eclipse of 15 November 1891.

Falling stars (1894). This record is from the Sicangu (Brule') High Hawk (41) winter count recorded by Curtis (1908: 159–82). There is an obvious relation between this and the Battiste Good (36) count. Howard (1979: 105) indicated that High Hawk was the son of Battiste Good and may have taken over his father's count, making modifications. The Battiste Good count recorded by Mallery (1893) ends with the 1879/80 entry and the copy of the count used by Mallery is at the National Anthropological Archives in Washington. Another copy labelled "Battiste Good" is located at the Sioux Indian Museum in Rapid City, South Dakota. This record book looks very old and well used and the entries continue to the year 1910 with no interpretation from 1880 on. The pictograph for 1894 (Plate 6) resembles a fireball and is very similar to the fireball glyph from this same count for 1821/22 (Plate 5). The pictographs throughout the Sioux Indian Museum copy are similar, but not identical, to the National Anthropological Archives copy throughout the period represented in both copies (compare Plates 5 and 6). The differences are in detail rather than in what is represented. Apparently Mallery's study ended with the 1879/80 entry, when Battiste Good made the copy for Corbusier which was used by Mallery, but the count was continued by Battiste Good, then by his son High Hawk. Indeed, High Hawk's name appears on the final pages of the Sioux Indian Museum copy. The glyph for 1894 in that copy must represent the falling stars referred to in the High Hawk count. Curtis did not publish many of the pictographs for the High Hawk count, but photographs do exist of them and sketches of the pictographs for 1822 and 1894 are shown in Figure 12.

Along with the year-name for 1894, Curtis recorded the following:

> The Superintendent of the U.S. Naval Observatory states that there is no record of a shower of meteors visible in the Dakotas in the winter of 1893–94. But November 23, 1892, there was a shower of unusual brilliancy visible from the Atlantic to the Pacific.

But this was certainly not a well-known shower. Perhaps it is the source of the High Hawk record for 1894 as well as for the glyph for the same year in the one copy of the Battiste Good count. It seems likely, however, that both records might have been intended to indicate fireballs. Again we note that fireballs

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occur with some frequency and can be spectacular. The keeper(s) of these counts might have witnessed a brilliant fireball (or more than one) and chosen it (them) as the year marker for 1894.

One star died (1903/04). This year entry for four Hunkpapa winter counts seems to indicate another fireball which was spectacular enough to have caused some winter count keepers to have selected it as the year-name. The High Dog (2) count interpretation is, "literally, Star-only one he died. A star died (disappeared)". Swift Dog (11) is, "One star died". Cranbrook (1) reads "Saw a Large Falling Star", and Praus (1962: 27) suggested that a particularly bright Leonid meteor on 14 November that year might explain the record. Finally, the unidentified Hunkpapa (3) count at the Robinson Museum, which has no year-names or interpretations, shows a star glyph for 1903/04.

Howard (1960a: 407) stated the opinion that the intended meaning was that a person named "One Star" died that year. In other cases where astronomical names of people have been used, the pictographs have shown a person with astronomical glyph attached. For example, both Swift Dog and High Dog record for the year 1877/78 that the Crow killed an individual named One Star and both show the year with a pictograph of a person with a star over his head. This is not the case with any of the four Hunkpapa counts for 1903/04. They all simply show a star (Figure 13). Therefore, it seems likely that the year was named in these counts after a fireball event. It is doubtful, however, that the fireball was one of the Leonids as suggested by Praus. Once again we must remember that fireballs are not uncommon. The keepers of these counts could have observed a bright fireball occurring at any time during the year. The fireball was probably not nearly so spectacular as the 1821/22 event, but still impressive enough in the minds of the keepers to be used. Perhaps their selection was influenced by the 1821/22 record. Here was another such event which reminded them of the previous one and so they responded to it by naming another year for a brilliant "dying star". We should also be aware that we are now dealing with a time when tribal traditions were not as strong as they once were. Some winter counts were still being kept, but probably not with as

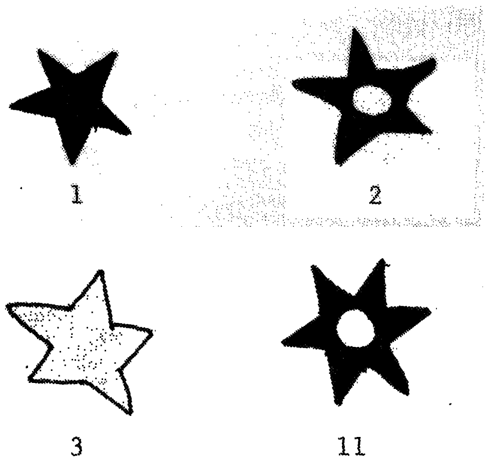

FIG. 13. Pictographs, redrawn by the author, for 1903/04. Numbers indicate winter counts as in Table 1.

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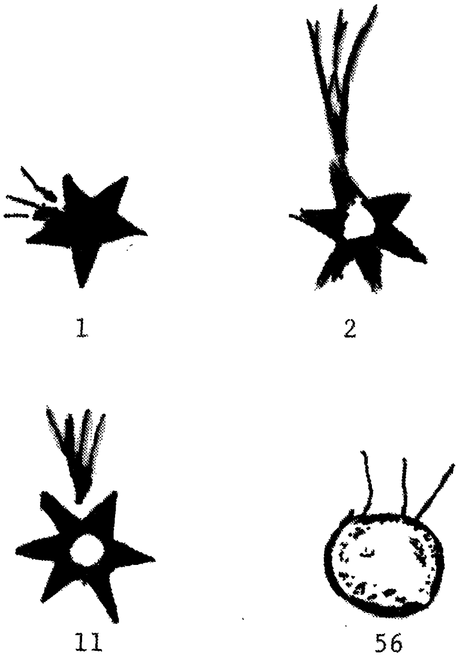

FIG. 14. Pictographs, redrawn by the author, for Comet Halley in 1910. Numbers indicate calendars as in Table 1.

much interest by the tribes generally. It was more likely that an individual keeper could make all the decisions relating to selection of year events, whereas earlier this was a matter of careful consideration by tribal leaders together with the keepers of the calendars.

There was a comet (1909/10). Six of the winter counts record Halley's comet. Both Wind-Roan Bear (49), a Yanktonai count, and Roan Bear (16), a Miniconjou count, list the comet in the correct year of 1910. The date for Bull Plume (56), a Peigan count, is shown by Raczka as 1908 and in the Glenbow copy as 1911. This is another indication of chronological problems with this count. Three are Hunkpapa counts. Swift Dog (11) misplaces the event in time, recording it for 1908/09. High Dog (2) correctly notes it in 1910. Cranbrook (1) lists it for 1909 and names the year, "Evening Star Seen in Daytime". All the pictographs, where there are any, show a star with a tail (Figure 14).

Even though it is possible that Venus, either as Evening Star or Morning Star, could be seen in the daytime, it is very unlikely that this would be used as a year-name in a winter count. It is possible to see Venus in daylight whenever the planet has a sufficient angular elongation from the Sun. A spectacular comet like Halley's, however, is quite unusual and is the sort of thing we would expect to find in winter counts. Indeed, we might well wonder why only six out of the twenty-seven calendars listed in Table 1 and which include the year 1910 mention the comet, which was so spectacular during May 1910. We might also wonder why other comets were not included in the winter counts. Throughout the period represented in the calendars there were many comets which were spectacular. Comets do not seem to have been considered very important, or at least not appropriate for calendric purposes, among the Indians keeping the calendars we have discussed.

Several winter counts record the death of Red Cloud in the winter count year 1909/10. He died in December 1909. In retrospect, it is ironically appropriate that this meteoric Indian leader was born in the year of the great fireball and died in the year of the most famous comet.

A star burned up (1911?). The Swift Dog (11) and High Dog (2) counts each show an additional pictograph of a star with a tail which appears to represent another fireball occurring sometime during 1910–12. The interpretation of the High Dog count reads, "Children had measles and the same year a star burned up". The pictograph (Figure 15) shows both a meteor and a person covered with spots. We can only assume that this is one more case of a fireball which was impressive enough to be included in these two winter counts.

In summer an eclipse of the sun (1918). The Kiowa calendar by Jimmy Auchiah (65) has a pictograph for the summer half of the year 1918 showing a tree with a sun disk over it (Figure 16). The interpretive text accompanying this reads: "In summer an eclipse of the sun. No crops growed and no rain. Fremont's wife died Mother of Henrietta." Whether or not there was an intended association between crop failure, lack of rain and the eclipse is not clear. There was a total eclipse of the Sun which swept down through Kiowa country on 8 June 1918 and this is the obvious source of this record.

Leonid Meteor Shower was seen in Rapid City (1966). Red Horse Owner's (31) winter count was being kept up to date as of 1969 when Karol published his description of it. Only two astronomical events are recorded in this interesting record. The first is the Leonid meteor shower of 1833. It is very appropriate that it also includes the most recent spectacular recurrence of this shower, which in earlier times had provided the best single chronological data point for winter counts in general. The notebook copy which was being kept current by Angelique Fire Thunder, granddaughter of Moses Red Horse Owner, had the following entry for 1966: "Bearitis Currery was found May 14, 1966 after one year. She disapped [*sic*] in 1965. November 17, 1966, Leonid Meteor shower was seen in Rapid City Thursday morning." The interpretation by Karol reads: "Beatrice Curry was found May 14 after one year, disappeared in 1965. Nov. 17 Leonid Meteor Shower was seen in Rapid City, Thursday morning in Allen." Angelique lived in Allen, South Dakota on the Pine Ridge Sioux Indian Reservation. Karol does not clarify where he obtained the information indicating that the meteor shower had been observed in Allen. The Leonid

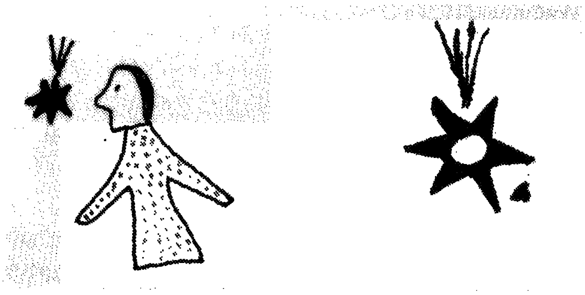

FIG. 15. High Dog (left) and Swift Dog (right) pictographs, redrawn by the author, for a possible fireball sometime during 1910–12.

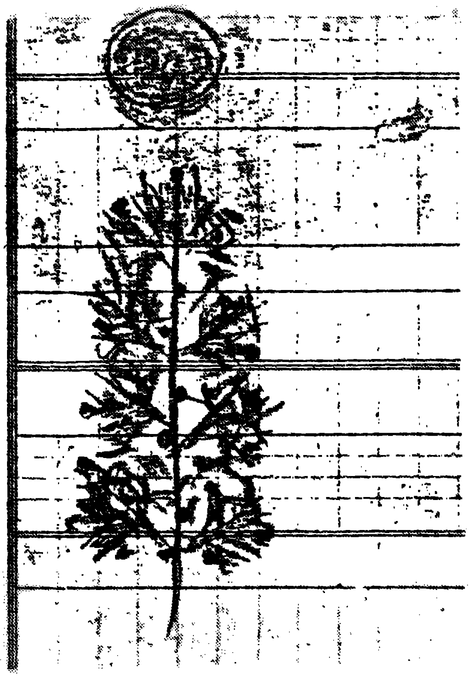

FIG. 16. Jimmy Auchiah pictograph for the total solar eclipse of 8 June 1918.

shower was quite spectacular for observers in the western United States generally, especially between 11.30 and 12.30 Universal Time, on the morning of 17 November. Rates of over 100,000 per hour were reported during part of that time (see *Sky and telescope* 1967).

SUMMARY AND CONCLUSIONS

We have studied records of seventeen possible astronomical events, coming from four cultural groups, among seventy-one Plains Indian calendars (fifty-one Sioux, two Mandan/Hidatsa, seven Blackfoot, eleven Kiowa) and narrowed them down to fourteen likely cases. These are summarized in Table 2. We find examples of five different types: four solar eclipses, three of them total and the fourth very nearly so; two total lunar eclipses; four probable fireballs, one of which was unusually spectacular; three of the most intense occurrances of the Leonid meteor shower, including the 1833 meteor blizzard; and one comet, the most famous one in history.

The types of events we have found are not surprising. Indeed, these are the events occurring in the sky which are most easily noticed and which we would expect to have special interest to traditional people: the types of events we would expect to find expressed in ritual and mythology. What *is* somewhat surprising, is that there were not more calendric records of some of these types of events.

It appears that all of the total lunar shadows crossing directly through the territories of the groups involved, during the periods of the calendars, caused at least some calendar keepers from each group to make record of the totally-eclipsed Sun. Of all of the objects of the sky, the Sun was of greatest interest to

TABLE 2. Summary of astronomical events in Plains Indian calendars.

Solar eclipse	Lunar eclipse	Fireball	Meteor shower	Comet	Calendar(s) and group(s) reporting
1782					Bull Plume (Peigan).
			1799		Bull Plume (Peigan).
		1821/22			33 Teton (Hunkpapa, Itazipco, Oohenupa, Miniconjou, Oglala, Sicangu); 4 Yanktonai. See Table 1.
			1833		All the calendars in this study which include the year 1833 (Sioux, Mandan/Hidatsa, Blackfoot, Kiowa).
1869					Unidentified Hunkpapa; Flame (Itazipco/Oohenupa); Bush, Lone Dog, Mato Sapa, Roan Bear, Swan (Miniconjou); Big Missouri, Iron Shell (Sicangu); Bull Plume (Peigan).
1878					George Hunt, Ah-nan-ti (Kiowa).
	1888/89				Short Man (Oglala); Bull Plume (Peigan).
	1891				Anko Monthly (Kiowa).
		1894			High Hawk, Battiste Good (Sicangu).
		1903			Cranbrook, High Dog, Swift Dog, unidentified Hunkpapa (Hunkpapa).
				1910	Cranbrook, High Dog, Swift Dog (Hunkpapa); Roan Bear (Miniconjou); Wind-Roan Bear (Yanktonai); Bull Plume (Peigan).
		1911/12			High Dog, Swift Dog (Hunkpapa).
1918					Jimmy Auchiah (Kiowa).
			1966		Red Horse Owner (Oglala).

the Plains calendar-keeping peoples. To what extent the eclipse records were influenced by the presence of Caucasians, is an interesting question to which some data have been supplied but which are for others to more fully evaluate.

During the time period covered by the calendars, there were many total and partial lunar eclipses which were not noted in the calendars. Perhaps their frequency is the reason they were *not* generally recorded: they were too common to use for remembering the passage of years; they were not singular events like the death of a particular person, a particular battle, or a particular set of circumstances which made the people suffer. Only occasional calendar keepers recorded lunar eclipses and their records became exceptional, rather than the rule.

Fireballs, too, are relatively common events which must have been noticed, from time to time, by people who spent lots of time outside. But one of these, the event of 1821/22, was unusually impressive, accompanied by acoustic phenomena, and could not be ignored in the winter counts of the Teton people. It was the exceptional calendar which did *not* employ this event to mark the year. The phenomenon must have been so spectacular that it was considered to be unlike any other before it, and it might have prompted a few Teton winter count keepers who become aware of other fireballs in later times (1894, 1903, 1911/12) to note them in their records. As far as we know, the Mandan, Hidatsa, Blackfoot and Kiowa did not record fireballs in their calendars. Either they did not observe truly spectacular meteoric events during the periods of their surviving calendars, or their calendric procedures did not accommodate such events, in view of other choices, as year markers.

The meteor blizzard of 1833 is the single most significant record in the calendars. Since it is found in all the calendars encompassing the year 1833, it is the best known data point for establishing the chronology of the counts. The Plains calendars confirm the intensity and duration of the 1833 shower compared to other meteor showers. We find just one winter count record of an earlier one (1799) and an interesting additional record (1966) from a nostalgic modern-day continuation of these old calendric methods.

The 1910 apparition of Halley's Comet was the only comet recorded in the calendars and this was at a time when Indians, as well as others, were undoubtedly saturated with news about this most famous comet. Why was it not recorded for 1835, and why were not other spectacular comets noted in Plains calendars? The reason for this dearth of comets in the calendars is, possibly, as seems to be the case with lunar eclipses, the fact that they were known to appear too frequently. Also, there may have been cultural reasons why comets were not selected, even when they were spectacular, and these customs may have broken down by 1910.

We have seen that one Peigan count (56) has an unusual number of astronomical entries, yet it is an uncertain record as far as the order of years is concerned. Taken as a whole, the astronomical content of the calendars is interesting, but we realize that there are relatively few astronomical memories in them when we consider the large number of possibilities. What does this tell us about the level of astronomical interest among the tribes from which the calendars were derived? The question is difficult, because we have not yet developed a structured set of indicies for use in evaluating comparative astronomical awareness and interest among various cultures. If we were to judge on the basis of the calendars alone, we might well conclude that astronomy was relatively unimportant among the Teton and Yanktonai Sioux, the Blackfoot and the Kiowa (the sample for the Mandan and Hidatsa is insufficient to draw conclusions). For example, from the calendars alone, we do not see evidence of anything remotely resembling the intensity of astronomical knowledge known to have existed among the Skidi Pawnee (Chamberlain 1982), the Chumash (Hudson *et al.* 1978) or the many tribes of southwest farming Indians.

But calendars are only one index. In order to make reasonable conclusions about comparative cultural astronomical knowledge, we would have to examine many other indices drawn from archaeology, material culture and ethnography. The greater the number of indices available for any particular group, the more certain we could be about the range, quantity, quality, and specific types of astronomical knowledge of that group. In addition to calendars, appropriate indicies would be: evidences of directional orientations and other factors derived from archaeological investigations; frequency and range of astronomical symbolic elements in arts and crafts; analyses and interpretations of astronomy found in mythology and folk lore; astronomical information revealed by linguistic analyses; and astronomical implications implied from analyses of observations of ritualistic and other social behaviours and activities. It is hoped that it will become possible to apply all of these indices to various American Indian and other cultures as various research methods continue to build the available informational foundation from which we can more fully appreciate the many ways the objects and phenomena of the sky have been important to humans on planet Earth.

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